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ABSTRACT

Developed during a project designed to provide continuous, performance-based vocational training at the secondary and postsecondary levels, this instructional guide is intended to help teachers implement a laterally and vertically articulated secondary level automotive mechanics program. Introductory materials include descriptions of Automotive Mechanics I and II, descriptions of secondary and postsecondary automotive mechanics programs, postsecondary course descriptions, secondary level automotive mechanics objectives, suggested automotive mechanics curriculum levels, suggested guidelines, discussion of sample tests provided in the guide, and suggested instructional time. Topics covered in the 13 units include an introduction; lubrication and vehicle operating maintenance; automotive engine maintenance, repair, and overhaul; fuel system maintenance and repair; emission controls and exhaust systems; cooling system, heater, and air conditioner maintenance and repair; electrical ignition systems; drive train; wheels and tires; steering and suspension; braking system maintenance and repair; automotive servicing; and servicing diesel fuel injection systems. Suggested instructional time and task listings begin each unit. For each task in a unit, some or all of the following are provided: performance objectives, performance actions, performance standards, recommended sources, related technical information, and other information the teacher might need. Appended to the basic document are: (1) a set of appendices that are relatively standard for the items in this series, and (2) a set of outcome-referenced tests. (YLB)

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# FINAL DOCUMENT FOR ARTICULATION OF AUTOMOTIVE MECHANICS

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## ARTICULATED, PERFORMANCE-BASED INSTRUCTION OBJECTIVES GUIDE FOR AUTOMOTIVE MECHANICS

May, 1983

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of The School District of Greenville County and
Greenville Technical College
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# ARTICULATED, PERFORMANCE-BASED CURRICULUM GUIDE

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## ARTICULATION GUIDE

THE SCHOOL DISTRICT OF GREENVILLE COUNTY AND GREENVILLE TECHNICAL COLLEGE

THE SCHOOL DISTRICT OF GREENVILLE COUNTY
GREENVILLE, SOUTH CAROLINA

REVISED 1983

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## ACKNOWLEDGEMENT

The *Articulated, Performance-based Instruction Guide for Automotive Mechanics* is the product of the work of the following instructors representing the secondary program of The School District of Greenville County and the post-secondary similar program at Greenville Technical College.

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The cooperation of these instructors and others representing The School District of Greenville County and Greenville Technical College is appreciated.

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## BIAS STATEMENT

This articulated, performance-based instruction guide has been developed based upon the tasks (objectives) and task actions (enabling objectives) important to the success of entry level workers in the vocation. The objectives were derived from task analysis and available tasks lists such as V-TEC Catalogs. The standards of performance are those expected by local businesses and industries for job success. Test samples are included to represent valid and reliable measures of the mastery of objectives.

This articulated, performance-based instruction guide has been designed to comply with the requirements of PL 94-482 Educational Amendments of 1976, Title II, which is intended to ". . .ensure that. . .curricula do not reflect stereotypes based upon sex, race, or national origin. . ."

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Every effort has been made to appropriately document any copyrighted material used in this articulated, performance-based instruction guide.

The objectives and task actions in this guide were based on their expertise and on task lists from resources such as V-TEC Catalogs. Standards included in this guide are those identified by local businesses and industries as important to the success of entry level workers. Sample knowledge and performance tests are included for the purpose of representing valid and reliable test items that may be used to measure mastery of objectives. Test samples taken from texts or workbooks typically are those being used locally and appropriate documentation has been included.

Wm. Edward Henderson, Jr., Coordinator
Occupational Education Articulation Program
The School District of Greenville County

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# ABSTRACT

Title of Project: Occupational Education Articulation Program: Automotive Mechanics

Project Coordinator: Wm. Edward Henderson, Jr.

Contracting Agency: The School District of Greenville County
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Greenville, S.C. 29602

Program Period: March 1, 1982, through February 28, 1983

PURPOSE: To develop a continuous line of vocational training in similar Automotive Mechanics programs so that students may continue their education at the secondary and post-secondary levels without loss of time or waste of effort in repeating tasks that have been mastered previously.

To provide a system where teachers can cooperate effectively in providing a continuous occupational development program where the level and type of training that leads to entry-level employment skills will be clear to students, teachers, other educators, and employers.

METHOD: Automotive Mechanics teacher representatives from four secondary level vocational centers of The School District of Greenville County and post-secondary level Automotive Mechanics teacher representatives from the Industrial Division, Greenville Technical College were brought together in task force committee meetings and workshops to survey very similar vocational courses of training to identify possible overlap or gaps as students continued Automotive Mechanics training from the secondary level to the post-secondary level. In addition, there was interest in lateral articulation of similar programs at the secondary level. An articulated, performance-based (competency-based) instruction objectives guide was developed by the Automotive Mechanics Task Force Committee to facilitate articulation. By the task analysis process, the Task Force Committee on Automotive Mechanics, identified the essential competencies for Automotive Mechanics for a student to continue training or for initial entry into the labor market in an Automotive Mechanics related field.

Major objectives for competency were stated, performances to obtain the objectives were identified and placed in sequential order, instruction time was estimated, and performance standards were stated. Finally, outcome-referenced (criterion-referenced) measures of competency were developed as a guide in articulating.

RESULTS: As a result of this project, the *Articulated, Performance-based Instruction Objectives Guide for Automotive Mechanics*, was developed. This articulation guide, however, is not a final product since it must be field trial tested and revised. Modifications and improvements to the Guide are expected since the process of education must be continually reviewed to ensure that objectives are valid and are being met as best they can be met under given conditions.

A *Policies and Procedures Guide* was developed to aid articulation activities in an earlier phase of the project and were used to direct articulation activities.

Two workshop guides, developed during the earlier phase of the project were used to assist task force committee participants in writing performance-based objectives, performance actions to reach the objectives, performance standards, and outcome-referenced tests.

These guides contain how-to-do-it sections distributed to teacher participants. The workshop guides and the *Policies and Procedures Guide* were revised during this phase of the articulation program.

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# AUTOMOTIVE MECHANICS I

LEVEL: Secondary

TITLE: Automotive Mechanics I

DESIGNATION: AUTO MECH I COMPUTER NUMBER: 743

DESCRIPTION: Automotive Mechanics I teaches the basic fundamentals of the gasoline automobile by allowing students to work on laboratory engines and mock-ups prior to actually undertaking actual repair jobs. Under the supervision of the instructor, students perform repair work on selected jobs brought into the automotive mechanics shop. The students become skilled in locating and diagnosing troubles and making repairs on all makes and models of gasoline automobiles. Generally, the working conditions and equipment found in the auto mechanics shop will be comparable to those of many large auto service departments.

OBJECTIVES: Meet minimum industry performance standards of performance in ...

Identification of shop safety hazards, practicing shop safety requirements, shop first aid; identifying, stating purpose, and demonstrating how to use and maintain common shop tools, equipment and machinery; identifying, stating purpose and application of Standard Shop Operating Procedures.

Identification and stating the purpose and operation of the major assemblies and their components and demonstration of operator maintenance of the modern gasoline fueled automobile.

Listing the vocational opportunities in the automotive maintenance field, practicing interpersonal relationships with the employer, fellow worker, and the customer.

Doing oil changes, vehicle lubrication, tire replacement and repair, and vehicle winterization.

Inspection, maintenance, removal and replacement of automotive cooling system components.

Inspection, service, maintenance, removal and replacement of automotive heater components, if automotive air conditioning is not taught.

Inspection, adjustment, repair, and replacement of brake systems.

Inspection, adjustment, replacement or repair of automotive fuel systems and components.

Inspection, adjustment, service, replacement or repair of automotive drive train with manual transmission.

Inspection, maintenance, repair, and replacement, or overhaul of the automobile gasoline engine, to include the engine system.

Inspection, service, maintenance, and repair, or replacement of components of the automotive air conditioning system, to include the automotive heater.

Inspection, service, adjustment, maintenance and repair, or replacement of components of the automatic transmission.

Inspection, maintenance, and repair, or replacement of components of the automotive electrical system.

Inspection, service, maintenance, and repair of automotive emissions control systems.

Practical application of completed instruction in a simulated automobile maintenance shop environment.

PREREQUISITES: None
Suggested Grade Level: 11

RECOMMENDED: For optimum success, students should be able to read at the tenth grade level and students who do not read at the eleventh or twelfth grade level may experience difficulty understanding shop manuals and specifications, repair instructions, and interpreting diagnostic equipment.

Mechanical aptitude and a high degree of manual dexterity typically are needed for success as an automotive mechanic.

Physically, the automotive student must be able to:
- stretch, bend, stoop, and reach
- lift, carry, and place heavy objects
- read fine markings on various gauges
- see and hear well, either naturally or with correction

- perform precise alignment and assembly of components

The student should like activities that:
- are mechanical
- use the hands to assemble and disassemble parts/assemblies
- involve diagnosing various malfunctions and problems
- involve performing intricate and precise operations on machines
- typically are indoor

The automotive mechanics student should be prepared to:
- work with hands in grease and oil
- follow written instructions in detail
- lift objects of considerable weight
- work in various positions
- follow safety rules to safeguard the well-being of all students in the shop
- accept responsibility for safeguarding expensive equipment
- explain to a customer what is being done and why

The student should have adequate math skills to:
- calculate rate and fees for labor and parts costs
- measure ratios and volume
- make precise measurements such as using the micrometer to 1/1,000 or 1/10,000 inch
- accurately computing arithmetic problems

REQUIRED/SUGGESTED INSTRUCTIONAL HOURS:

| System | Year | | |
|---|---|---|---|
| Division | Class | Lab | Total |
| Credits | 3 | - | 3 |
| Hours | 540 | - | 540 |

LEVEL: Secondary

TITLE: Automotive Mechanics II

DESIGNATION: AUTO MECH II COMPUTER NUMBER: 744

DESCRIPTION: Automotive Mechanics II reviews, expands, and applies the principles learned in Automotive Mechanics I.

OBJECTIVES: Upon completing Automotive Mechanics II, the student should demonstrate competency in Automotive Mechanics (D.O.T. 620.281) tasks by:

Repairing, overhauling, and maintaining automotive vehicles by applying knowledge of service procedures, and using hand and power tools as well as specialized automotive equipment; discussing with customers or reading work orders and examining and testing vehicles to determine the nature and extent of repairs or service required. Removing units, such as engine, transmission, or differential, using wrenches and hand tools, and inspecting parts for wear and defects, visually and by using micrometers and gauges. Repairing or rebuilding units, using hand, power, and machine tools. Replacing units in vehicle, and aligning and securing using hoist and hand tools. Tuning engines and testing the functioning of vehicles with electronic diagnostic equipment. Repairing and overhauling other standard automotive systems such as cooling, electrical, fuel, exhaust, and steering systems, and specialized units. Recording work done and parts and materials used, on work order or job ticket, and vehicle condition report.

PREREQUISITES: Automotive Mechanics I
Suggested Grade Level: 12

REQUIRED/SUGGESTED INSTRUCTIONAL HOURS:

| System | Year | | |
|---|---|---|---|
| Division | Class | Lab | Total |
| Credits | 3 | - | 3 |
| Hours | 540 | - | 540 |

**PERFORMANCE EVALUATION:**

Given typical situations with an automobile, the student will demonstrate such services as lubrication, changing or adding fluids to the automobile, battery servicing, servicing tires, and inspecting and replacing systems components according to specifications and to meet minimum industry performance standards.

Given basic automotive servicing tools, equipment, and machines, typical automotive situations to service, the student, within the scope of his/her training and experience, will locate and diagnose faults and make the necessary adjustments, repairs, replacements, or service so the automobile will meet minimum industry performance standards.

Through outcome-referenced measures of knowledge and skill, the student will demonstrate the competencies expected to successfully enter the automotive mechanics field or to qualify for additional mechanical training in specialized automotive servicing or in diesel engines.

**JOB QUALIFICATION:**

In training, just as it is in the field of work, individual differences and interests must be recognized.

Successful completion of all modules of training should qualify the graduate to enter the automotive mechanics field as an *Automotive Technician*.

With a minimum of at least one year of successful experience in an automotive maintenance shop, the graduate should be qualified to become a *Master Automotive Technician* and to pursue certification in automotive servicing.

Graduates who do not satisfactorily complete the full course of training may be competent to qualify for one of the following specialized areas of servicing.

- Service Station Specialist
- Automotive Brake Technician
- Automotive Fuel System Maintenance-Repair Technician
- Manual Transmission and Rear Axle Technician
- Automotive Front End Technician
- Automotive Heating - Air Conditioning Technician
- Automotive Transmission Technician
- Automotive Electrical Systems Technician

Other graduates who demonstrate competency in only part of the total scope of training may qualify for initial employment in one of the following areas of the automotive servicing field.

- Tire Servicing
- Auto Parts Counter Service

Skilled mechanics usually earn between two and three times the hourly rate as entry level workers without experience.

WORKING CONDITIONS:

Most automotive mechanics work between 40 and 48 hours a week, but many may work even longer during busy periods. Often, hourly workers earn overtime rates for additional work.

Typically, mechanics work indoors. Modern automobile service departments generally are well ventilated, heated, and lighted. Older or smaller service shops may not have these advantages.

Automotive mechanics typically work with dirty and greasy parts, and in awkward positions. Minor cuts and bruises are common. Serious accidents may be avoided by observing good safety practices.

Typically the automobile repair business is not very vulnerable to changes in economic conditions and mechanics can expect steady work.

The majority of automotive mechanics will work in shops of less than five persons.

## SECONDARY DESCRIPTION

## AUTOMOTIVE MECHANICS

Graduates of Automotive Mechanics have been trained in the basic fundamentals of the automobile. Under the close supervision of the instructor, work is conducted on laboratory engines and mock-ups prior to the student accomplishing selected repair jobs that are brought into the automotive mechanics laboratory. Graduates are competent diagnose and locate troubles of all makes and models of automobiles and are able to make the necessary repairs or replacements to engines, fuel or other systems, and various accessories. The working conditions, tools, and equipment found in automotive mechanics laboratory are comparable to those found in most large auto service departments.

Recommended course content includes:

1. Safety
2. Proper techniques of using hand tools
3. Service manuals
4. Test equipment
5. Body service
6. Engines
7. Transmissions
8. Fuel systems
9. Electrical systems
10. Cooling systems
11. Suspensions
12. Braking systems
13. Diagnosis
14. Estimating cost

Outline of High School Credit Courses, Columbia, SC: State Department of Education, p. 126, 1980.

## POST-SECONDARY DESCRIPTION

## AUTOMOTIVE MECHANICS

To keep up with increasing technology automotive mechanics covers, such topics as emission controls, air conditioning systems, complex electrical, vacuum, and hydraulic accessories, and much more that tomorrow's automotive technician must know. The technician is thoroughly trained in theory, diagnostic techniques, and a wide variety of automotive servicing skills.

Automotive Mechanics is a four quarter diploma program offering training in the technical and manual skills essential to the testing, diagnosis, and servicing of motor vehicles.

Suggested Sequence of Required Courses:

### FIRST QUARTER

| COURSE NUMBER | COURSE TITLE | CLASS | LAB | CREDIT |
|---|---|---|---|---|
| MAT 167 | Applied Math - Automotive | 5 | 0 | 5 |
| AUT 111 | Power Plant Fundamentals | 4 | 3 | 5 |
| AUT 112 | Fundamentals of Automotive Electricity | 3 | 3 | 4 |
| AUT 128 | Tools & Equipment, Use, Care and Maintenance | 2 | 3 | 3 |
| WLD 125 | Automotive Welding | 3 | 3 | 4 |
| | | 17 | 12 | 21 |

### SECOND QUARTER

| COURSE NUMBER | COURSE TITLE | CLASS | LAB | CREDIT |
|---|---|---|---|---|
| ENG 151 | Language Applications | 3 | 0 | 3 |
| PHY 111 | Applied Physics | 3 | 0 | 3 |
| AUT 123 | Fuel Systems and Carburetion | 3 | 6 | 5 |
| AUT 124 | Electrical Systems I | 4 | 6 | 6 |
| | | 13 | 12 | 17 |

### THIRD QUARTER

| COURSE NUMBER | COURSE TITLE | CLASS | LAB | CREDIT |
|---|---|---|---|---|
| PSY 112 | Industrial Human Relations | 3 | 0 | 3 |
| AUT 121 | Internal Combustion & Engine Reconditioning | 4 | 12 | 8 |
| AUT 133 | Power Train I | 2 | 6 | 4 |
| AUT 109 | Automatic Transmission Systems | 2 | 3 | 3 |
| | | 11 | 21 | 18 |

### FOURTH QUARTER

| COURSE NUMBER | COURSE TITLE | CLASS | LAB | CREDIT |
|---|---|---|---|---|
| AUT 132 | Brakes I | 5 | 3 | 6 |
| AUT 142 | Steering and Suspension Systems I | 2 | 6 | 4 |
| AUT 143 | Automotive Accessories | 2 | 3 | 3 |
| AUT 131 | Automotive Diagnosis and Repair I | 3 | 3 | 4 |
| ECO 100 | Consumer Economics | 3 | 0 | 3 |
| | | 15 | 15 | 20 |

Additional Fees and Requirements for Automotive Mechanics include:

Uniform clothing as specified.
Personal tool set.
Safety glasses.
Textbooks as specified.

Industrial Division Catalog, Greenville Technical College, Greenville, SC: Greenville Technical College, p. 8-9, 1980.

# POST-SECONDARY COURSE DESCRIPTION

## AUTOMOTIVE MECHANICS

### MAT 167 APPLIED MATH I - AUTOMOTIVE

"Mathematical applications for automotive repairmen. (5-0-5)

### AUT 111 POWER PLANT FUNDAMENTALS

"Student learns automotive fundamentals, principles of engine operations, including HP calculations, efficiency combustion theory, etc. Types of engines, cylinders, and valve arrangements, lubrications, fuel exhaust systems and cooling are also included. (4-3-5)

### AUT 112 FUNDAMENTALS OF AUTOMOTIVE ELECTRICITY

"A study of the fundamentals of electricity and magnetism. This course familiarizes the student with basic circuits, batteries, cranking motors and ignition system. (3-3-4)

### AUT 128 TOOLS & EQUIPMENT, USE, CARE, & MAINTENANCE

"Students gain knowledge in the proper selection of tools and equipment, when to use, proper applications including maintenance and safety. (2-3-3)

### WLD 125 AUTOMOTIVE WELDING

"A study of principles of oxyacetylene and arc welding, basic principles of cutting and applications of each as applied to auto repairs. (3-3-4)

### AUT 123 FUEL SYSTEMS AND CARBURETION

"A basic course of gasoline engine fuel system study. This includes principles of carburetion and components of the fuel systems, such as fuel pumps, system plumbing, manifolding and fuel injecting. (3-6-5)

### AUT 124 ELECTRICAL SYSTEMS I

"An advance study is made of electrical systems components and operation. Included in this study are printed circuits, alternators and generators, various types of wiring including those used on commercial vehicles. All components are checked with modern testing and diagnostic equipment. The student will demonstrate his mastery of the subject by troubleshooting electrical systems and repairing based on his findings. (4-6-6)

### AUT 121 INTERNAL COMBUSTION ENGINE RECONDITIONING

"The step process of engine overhaul is accomplished through class discussion and shop demonstrations with student participation. Students are required to perform in all phases of "rebuild": cleaning, specifications, pertinent measurement, assembly and "runin" of unit. "Live" engines are utilized and made operational. (4-12-8)

### AUT 133 POWER TRAIN I

"A study of clutches, conventional automotive transmissions and overdrives. Included are drive line with universal joints, differentials and rear axles. The student will demonstrate his ability to rebuild each of these units. (2-6-4)

### AUT 109 AUTOMATIC TRANSMISSION SYSTEMS

"A basic study of automatic (hydraulic) transmissions by an individual study of fluid couplings, torque converters, principles of automatic controls and planetary gear systems, with maintenance and repair service included. (2-3-3)

### AUT 132 BRAKES I

"A study of the fundamentals hydraulic laws and their application to automotive brake systems. Students will be performing periodic preventive maintenance, rebuilding hydraulic systems, replacing brake shoes and servicing the disc brake systems. (5-3-6)

### AUT 142 STEERING & SUSPENSION SYSTEMS I

"A technical and practical study of the principles of automobile and truck suspension systems, including steering, alignment and wheel balancing. The student becomes familiar with the use and application of balancing and alignment equipment. (2-6-4)

### AUT 143 AUTOMOTIVE ACCESSORIES

"This study includes short sessions on the various types of automotive accessories designed for safety and comfort. Students will troubleshoot and/or make repairs and adjustments on automotive accessories.

### AUT 131 AUTOMOTIVE DIAGNOSIS & REPAIR I

"A practical study by correlating previous instructions, diagnosing to determine cause of a specific problem, performing preventive maintenance and repair services. The student will become proficient in performing these services and in the use of diagnostic and repair equipment. (3-3-4)

*Industrial Division Greenville Technical College*, Greenville, SC:
Greenville Technical College, pp. 37-38, 59, 1980-82.

## SCOPE OF PROJECT
## AUTOMOTIVE MECHANICS

(Similar Training)

| Secondary Level (Year or 9-months system) | Post-secondary Level (Quarter system) |
|---|---|
| Automotive Mechanics I | AUT 111 - Power Plant Fundamentals |
| Automotive Mechanics II | AUT 112 - Fundamentals of Automotive Electricity |
|  | AUT 128 - Tools and Equipment, Use, Care and Maintenance |
|  | AUT 123 - Fuel Systems and Carburetion |

Unless otherwise specified, secondary level courses are based on the 180 day school year system and post-secondary level courses are based on the quarter system.

The post-secondary level courses are those of the Automotive Mechanics Program, Industrial Division, Greenville Technical College.

# SECONDARY LEVEL
# AUTOMOTIVE MECHANICS

## OBJECTIVES

Meet minimum industry performance standards of performance in...

Listing the vocational opportunities in the automotive maintenance field, practicing interpersonal relationships with the employer, fellow worker, and the customer.

Identification of shop safety hazards, practicing shop safety requirements, shop first aid; identifying, stating purpose, and demonstrating how to use and maintain common shop tools, equipment and machinery; identifying, stating purpose and application of Standard Shop Operating Procedures.

Identification and stating the purpose and operation of the major assemblies and their components and demonstration of operator maintenance of the modern gasoline fueled automobile.

Performing oil changes, vehicle lubrication, tire replacement and repair, and vehicle winterization.

Inspection, maintenance, removal and replacement of automotive cooling system components.

Inspection, service, maintenance, removal and replacement of automotive heater components.

Inspection, service, maintenance, and repair, or replacement of components of the automotive air conditioning system.

Inspection, adjustment, repair, and replacement of brake systems.

Inspection, adjustment, replacement or repair of automotive fuel systems and components.

Inspection, adjustment, service, replacement or repair of automotive drive train with manual transmission.

Inspection, service, adjustment, maintenance and repair, or replacement of components of the automatic transmission.

Inspection, maintenance, repair and replacement, or overhaul of the automobile gasoline engine, to include the engine system.

Inspection, maintenance, and repair, or replacement of components of the automotive electrical system.

Inspection, service, maintenance and repair of automotive emissions control systems.

Inspection, service, adjustment, maintenance and repair, or replacement of automotive diesel engine systems such as the full-ignition system.

Practical application of completed instruction in a simulated automobile maintenance shop environment.

## SUGGESTED

## AUTOMOTIVE MECHANICS CURRICULUM LEVELS

### RATIONAL

The secondary Automotive Mechanics curriculum has been described in a laterally articulated sequence based on current instructional practices and so that the student will progress through three distinct levels of knowledges and skills competency that should result after introductory training, and completion of the first year, and graduation from the two-year secondary program. The curriculum design should prepare the student who desires to obtain part-time employment in automotive mechanics while completing high school.

### LEVEL I

During initial training, the automotive mechanic student will acquire the necessary knowledges and skills to service automobiles, trucks, and other automotive vehicles with fuel, lubricants, and accessories.

Fills the fuel tank of vehicles with gasoline or diesel fuel to a level specified by a customer. Observes the level of oil in the crankcase and the amount of water in the radiator, and adds required amounts of oil and water. Adds necessary amount of water to battery, and washes windshield of vehicle. Lubricates vehicle and changes the motor oil (LUBRICATION SERVICER). Replaces accessories, such as oil filter, air filter, windshield wiper blades, and fan belt. Installs antifreeze and changes spark plugs. Repairs or replaces tires (TIRE REPAIRER). Replaces lights, and washes and waxes vehicle. Collects cash from customer for purchases and makes change or charges purchases using customer charge plate. May adjust brakes (BRAKE ADJUSTER). May sell batteries and automobile accessories usually found in service stations. May assist in arranging displays, taking inventories, and making daily reports.

Possible entry employment might include (SERVICE STATION ATTENDANT) or apprentice (LUBRICATION SERVICER), (TIRE REPAIRER), (BRAKE ADJUSTER), OR (PARTS COUNTER WORK).

### Level II

Designed as a continuation of Level I curriculum, Level II emphasizes additional indepth study of each unit of the automobile. Completion of this curriculum level will provide the student with job-entry skills at the beginning trainee or apprenticeship level.

Performs minor repair and tune-up of automotive vehicles. Removes and replaces spark plugs, ignition contact points, and condenser, using hand tools. Attaches leads of electronic engine tester, or of voltmeter and timing light, and makes minor adjustments on carburetor and timing to improve performance, using hand tools.

Services, replaces, and adjust electrical and fuel system components, according to manual specifications, using special and standards hand tools.

Cleans and adjust throttle and choke linkages. Replaces components, such as shock absorbers, brake shoes, wheel bearings, lights, radiator caps, batteries, and filters. Adjust brakes to remedy minor defects. Removes, repairs, and replaces tires and tubes, using impact wrench and pneumatic tire changer. Replaces defective components of exhaust system. Lubricates (LUBRICATION MAN), refuels, tests, and services cooling system of vehicles.

Employment while completing training might be as an (APPRENTICE MECHANIC) mechanic trainee in an auto service business.

## LEVEL III

Curriculum Level III is a continuation of Level II. It covers the entire automobile in greater detail, providing students with the knowledges and skills to enable them to perform diagnosis and repair of various automotive components and systems.

Repairs and overhauls automobiles, trucks, and other automotive vehicles. Examines a vehicle (AUTOMOBILE TESTER, DIAGNOSTICIAN) and discusses with the owner (REPAIR-SERVICE ESTIMATOR, SERVICE WRITER) the nature and extent of malfunction, damage or service needed. Plans work procedures, using technical manuals, and experience. Raises vehicle, using hydraulic jack or hoist, to gain access to mechanical units bolted to underside of vehicle. Removes units, such as engine, transmission, or differential, using wrenches, and special equipment. Disassemblies unit and inspects parts for wear, using micrometers, calipers, and thickness gauges. Repairs and replaces parts, such as pistons, rods, gears, valves, and bearings, using mechanic's hand tools. Overhauls or replaces carburetors, blowers, generators, distributors, starters, and pumps. Rebuilds parts, such as crankshafts and cylinder blocks, using lathers, shapers, drill presses, and welding equipment. Rewires ignition system, lights, and instrument panel. Relines and adjusts brakes, align front end, repairs or replaces shock absorbers, and repairs minor leaks in radiators. Replaces and adjusts headlights and installs and repairs accessories, such as radios, heaters, mirrors, and windshield wipers.

Employment, typically, will be entry level as an apprentice mechanic in such areas as: (AUTOMOBILE MECHANIC, MOTOR), (FOREIGN CAR MECHANIC), (SERVICE STATION MECHANIC), (DIAGNOSTIC TECHNICIAN), (SERVICE MANAGER TRAINEE), (BRAKE - FRONT END SPECIALIST), (WHEEL ALIGNMENT SPECIALIST), or (MECHANIC).

## SUGGESTED GUIDELINE
## THREE LEVELS, TWO YEAR
## AUTOMOTIVE MECHANICS TRAINING
## (Secondary Level)*

(*Post-secondary level encompasses training described, on a one year program.)

| 1st Year | | 2nd Year |
|---|---|---|
| 1. INTRODUCTION TO AUTOMOTIVE TECHNOLOGY | | |
| Level I (15 hours) | Level II (5 hours)<br>(Level I plus 5 hrs. = 20 hrs.) | Level III (5 hours)<br>(Level II plus 5 hrs. = 25 hrs.) |
| A. (Sub-module) SAFETY | | |
| Recognizes all phases of shop and personal safety as practiced in the automotive service industry and defined by local, state, and federal safety regulatory agencies. School and shop regulation and personal safety practices are an integral part of all segments of performance. | Level II is based upon the information presented in Level I. | Level III is based upon the information presented in Level I and II. |
| Practices shop safety. (Fire, cleanliness, orderly work area, lifting, acid, good ventilation, etc.) | | |
| Follow required procedures for shop hazard emergencies. (Burns, electrical shock, injury, poison, carbon monoxide, fumes, etc.) | | |

B. (Sub-module) CAREER OPPORTUNITIES

| | | |
|---|---|---|
| Compares opportunities in the automotive service industry (career education). | Contrasts vocational career information concerning the automotive maintenance industry, interpersonal relationships of the mechanic and fellow employers/supervisors, the customers, fellow workers, and the craft. | Expands knowledge concerning job description.<br>Recognize opportunities and job availability for the Automotive Technician.<br>Identify how to get a job, hold a job, and earn advancement. (Good references, first impressions, reliability, quality performance, etc.)<br>Identify how to meet people and to be accepted by fellow employeees.<br>Enumerate the technician's responsibilities toward his employer, the customer, and his craft. (The work ethic, honesty, legal concerns, public relations, and shop image, etc.) |

C. Job Performance and Work Attitude

D. Shop Math

|  |  |
|---|---|
| E. (Sub-module) TOOLS, EQUIPMENT, AND MACHINERY |  |
| Identifies, uses properly, and maintains common hand tools and measuring devices. | Additional emphasis is placed on the proper use of advanced equipment. |
| Identifies and uses properly items of common shop equipment. (Jacks, lifts, air compressors, etc.) |  |
| Identifies, and uses properly items of common used shop machinery. (Grinders, drills, etc.) |  |
| F. (Sub-module) AUTOMOTIVE FASTENERS |  |
| Identifies and uses automotive fasteners. __________ __________ __________ | Uses automotive fasteners correctly. |
| G. (Sub-module) SHOP PRACTICES/PROCEDURES |  |
| Able to choose and use related technical information, shop practices and Standard Shop Operating Procedures. | Familiar with and correctly applies Standard Shop Operating Procedures. (Flat Rate Manual, Job Orders, Parts Requisitions, Common Shop Terminology.) |

## H. (Sub-module) INTRODUCTION TO AUTOMOTIVE SYSTEM

The Motor Vehicle: Major Assembly Identification, Primary Components of Assemblies, Assembly and Vehicle Mechanical Operation and Driver Maintenance.

Lubrication and Tires: Classifies types, purpose, application, and operator maintenance.

Cooling System: Explain purpose, operation, major parts, and operator maintenance.

Braking System: Recognize purpose, operation, major parts, and operator maintenance.

Fuel System: Identifies purpose, types of fuel, system operations, major parts, and operator maintenance.

Steering System and Front End: Studies purpose, operations, major parts, and operator maintenance.

Power Train and Manual Transmission: Identifies purpose, operations, major parts, and operator maintenance.

Engine: Explains purpose, operations, major parts, and operator maintenance.

Automobile Heater and Air Conditioners: Studies purpose, operation, major parts, and operator maintenance.

Automatic Transmission: Interprets purpose, operation, major parts, and operator maintenance.

Automotive Electrical Systems: Identifies purpose, operations, major parts, and operator maintenance.

Emissions Control: Explains purpose, operation, major components, and operator maintenance.

2. LUBRICATION

Level I (5 hours)

Level I students interprets theory, nomenclature, basic construction, and operation of various types of automotive engines, including fuels, combustion, lubrication, and other engine support systems. ---------- ---------- ----------

According to manufacturer's specifications and to meet minimum industry performance standards.

1. Check fluid levels*
2. Change oil and air filters
3. Lubricate vehicles and equipment

*See also Level I tasks in other automotive systems.

## 3. AUTOMOTIVE ENGINE--MAINTENANCE, REPAIR, AND OVERHAUL

Level I

(See Lubrication and Vehicle Operating Maintenance.)

(20 hours)
(Level I plus 20 hrs. = 30 hrs.)

Level II is based upon the basic skills and knowledges developed in Level I. Differentiates repairs to automotive engines including gasket, seal, and component replacement. Demonstrates proper use of basic diagnostic equipment such as compression gauges and leak testers. Able to:

1. Perform Engine Vacuum Test and Determine Needed Repairs
2. Replace valve cover gaskets;
3. Replace outside seals;
4. Replace and repair motor mounts.

(55 hours) Engine servicing
(Level II plus 55 hrs. = 85 hrs.)

Level III identifies more advanced theory of reciprocating, rotary, diesel, 2-cycle and 4-cycle, air- and liquid-cooled, internal combustion engines. Increases experiences typical at job shops.

Perform inspections, maintain, repair, replace, and overhaul the automotive gasoline engine (less electrical and fuel systems); according to manufacturer's specifications and to meet minimum industry performance standards.

1. Service cylinder heads;
2. Service valve trains; general
3. Measure and service cylinders and replace piston rings;
4. Check and replace main and rod bearings;
5. Remove and replace engines;
6. Perform major overhauls, including measuring, removing, and replacing such major components as crankshafts, camshafts, and connecting rod and piston assemblies.

**ENGINE-MAINTENANCE, REPAIR, AND OVERHAUL TASKS INCLUDE:**

- Clean engines.
- Inspect exhaust systems.
- Inspect or remove and replace exhaust manifolds.
- Remove and replace engine mounts.
- Perform operational inspections of positive crankcase ventilation systems.
- Repair or service crankcase ventilation systems.
- Run compression test.
- Perform cylinder leakage test.
- Perform cylinder balance test.
- Diagnose valve train and head malfunctions.
- Clean engine parts and make visual check for condition.
- Remove and replace pan and valve covers.
- Perform operational inspections of engine lubrication systems.
- Remove and replace gaskets and seals.
- Remove and replace head gaskets.
- Inspect head for warp.
- Adjust valves.
- Remove and replace valves.
- Grind valves.
- Resurface valve seats.
- Remove and replace camshaft.
- Remove and replace camshaft bearings.
- Remove and replace valve lifters.
- Knurl valve guides.
- Remove and replace oil pumps.
- Repair oil pumps.
- Remove and replace timing gears and chains.
- Remove and replace flywheel.
- Remove and replace flywheel ring gears.
- Remove and replace engines from vehicles.
- Remove and replace connecting rods and bearings.
- Remove and replace pistons.
- Remove and replace rings on pistons.
- Remove and replace crankshaft and bearings.
- Inspect crankshaft and connecting rod assembly using micrometers and other equipment.
- Inspect and correct bearing fit.

## 4. FUEL SYSTEM MAINTENANCE AND REPAIR

(15 hours)

Develops a thorough understanding of the principles of carburetion, exhaust, and fuel, delivery systems and components.

(80 hours)
(Level I plus 80 hrs. = 95 hrs.)

Level II depends upon the knowledges and skills developed in Level I.

Performs inspections, adjusts, repairs, or replaces, and components of the automotive fuel system, according to manufacturer's specifications and to meet minimum industry performance standards.

1. Clean or replaces fuel filter units.
2. Removes, services, or replaces fuel pumps or fuel lines and hoses.
3. Installs carburetor.
4. Inspect and measures fuel flow and pressure of system.
5. Adjust carburetor.
6. Inspects, cleans, and adjusts choke unit (automatic and manual).
7. Inspects, services, or replaces gas tank, cap and sending unit.
8. Repairs or services carburetors.
9. Adjust fuel injection system.

(80 hours)
(Level II plus 80 hrs. = 175 hrs.)

Level III is dependent upon the knowledges and skills developed in Level I and II. Instructional emphasis is placed on the diagnosis and service of carburetors, fuel pumps, fuel gauges, tank units, and emission control devices.

Upon completion, the student is able to:

1. Rebuild carburetors.
2. Diagnose and repair fuel system malfunctions.

## 5. EMISSIONS CONTROL AND EXHAUST SYSTEM

...Hours are included as part of Fuels...

### Level I

Knowledgeable of air pollution, factors involved in an contributing to automotive emissions types and operations of common emissions controlled by U.S. automobile makers as well as leading foreign makers.

1. Study the air pollution problem.
2. Interpret factors involved in and contributing to automotive emissions.

Inspection and replacement of aid cleaners, heat risers, PCV valves, and exhaust systems may be covered at this level. Upon completion, the student is able to:

1. Service PCV system.
2. Inspect exhaust system for leaks or damage.

### Level II

Develops the knowledges and skills required to inspect, service, repair, or replace the six most common emissions control system.

1. Services, repairs, or replaces positive crankcase ventilation systems.
2. Check and service fuel evaporation systems.
3. Services, repairs, or replaces air injection systems.
4. Services, repairs, or replaces thermostatic air cleaners.
5. Test and service exhaust gas recirculation value operation.
6. Services, repairs, or replaces engine modification systems.
7. Removes and replaces catalytic converter.
8. Inspects, removes, and replaces tail pipe and/or muffler.

### Level III

Diagnoses and repairs individual manufacturers' emission control system components.

## 6A. COOLING SYSTEM

(20 hours)

### COOLING SYSTEM MAINTENANCE AND REPAIR

Perform inspections, maintain, remove and replace automotive systems components; according to manufacturer's specifications and to meet minimum industry performance standards.

Interprets the theory and operation of engine cooling system. Able to:

1. Check and correct coolant level.
2. Replace and/or adjust belts.
3. Check and test radiator cap.
4. Inspect and replace hoses.
5. Check coolant freezing point.
6. Pressure test cooling system.

## 6B. HEATING

(20 hours)
(Level I plus 30 hrs. = 50 hrs.)

### AUTOMOTIVE HEATER MAINTENANCE AND REPAIR

Perform inspections, maintain, service, remove, and replace the automotive heater, as an item separate from the air conditioner; according to manufacturer's specifications and to meet minimum industry performance standards.

Level II builds on the knowledges and skills developed in Level I. Knows passenger hearing systems and related control systems. Able to:

1. Check and replace water pumps, freeze plug, fan-clutch.
2. Check and replace heater controls.
3. Inspect and replace defroster hose.

## 6C. AIR CONDITIONING

(15 hours)
(Level II plus 15 hrs. = 65 hrs.)

### AUTOMOBILE AIR CONDITIONER MAINTENANCE AND REPAIR

Perform inspections, service, maintain, repair or replace components of the automobile air conditioner system; according to manufacturer's specifications and to meet minimum industry performance standards.

(Automotive Heater may be integrated into this instruction)

Level III continues developing the knowledges and skills acquired in Level I and II. Demonstrates installing, servicing, and troubleshooting of air conditioners. Able to:

1. Check air conditioner for satisfactory operation.
2. Service air conditioner control components.
3. Discharge system.
4. Remove and replace air conditioner fan motor.
5. Remove and replace dryer in air conditioning unit.

7. Test and replace thermostat.
8. Check overflow tank and accessories.
9. Remove and reinstall radiators.
10. Chemically clean and flush cooling system.
11. Perform chemical test on Coolant System.
12. Replace water pump.
13. Replace variable speed fan.
14. Replace core (freeze) plugs.

4. Replace heater water control core.
5. Diagnose heating system malfunctions.

6. Remove and replace freon control valve in air conditioning unit.
7. Remove and replace expansion valve in air conditioning unit.
8. Remove and replace compressor seals.
9. Remove and replace condenser in air conditioning unit.
10. Remove and replace evaporator in air conditioning unit.
11. Repair or remove and replace air conditioning compressor.
12. Pressure test, performance test, and leak test the system.
13. Diagnose air conditioning malfunctions.
14. Repair a/c electrical circuits.

## 7. AUTOMOTIVE ELECTRICAL SYSTEMS MAINTENANCE AND REPAIR

Inspects, maintains, repairs, or replaces only the automotive engine electrical system, the battery, and replaces bulbs and fuses of the lighting system.

Expands the competency of the mechanic to perform tasks of--AUTOMOTIVE ENGINE--MAINTENANCE, REPAIR, AND OVERHAUL (previously described).

(Highest skill level) Inspects, maintains, repairs, or replaces all components of the automotive electrical system; according to manufacturer's specifications and to meet minimum industry performance standards.

| (30 hours) | (100 hours)<br>(Level I plus 100 hrs. = 130 hrs.) | (120 hours)<br>(Level II plus 120 hrs. = 250 hrs.) |
|---|---|---|
| Applies basic electrical theory and nomenclature to perform minor service on the electrical system and minor servicing of electrical components. Able to: | Level II builds upon the experience gained in Level I. Expands theory, in greater detail, and ability to diagnose electrical system problems. Electrical service procedures skills and knowledge for the overhaul of electrical units are expanded. Uses diagnostic equipment to locate system malfunctions. Able to: | Level III is a continuation of Levels I and II. Indepth knowledge of electronic systems and components is gained along with knowledge and skill in more sophisticated testing procedures. Able to: |
| 1. Check spark plugs and replace as needed. | 1. Set ignition timing. | 1. Evaluate alternator, generator and regulator output. |
| 2. Check spark plug wiring. | 2. Replace generators or alternators. | 2. Analyze or adjust engine performance using engine analyzer. |
| 3. Clean and replace distributor cap towers, wiring, and other minor electrical units. | 3. Replace starters. | |
| 4. Service charging system output, adjust belt, replace belt. | 4. Replace starters solenoids. | |
| | 5. Repair generators or alternators. | |
| | 6. Analyze malfunctions in the cranking system. | |

5. Test, service or replace batteries, cables, and battery boxes.
6. Perform operational inspections of lighting and electrical systems.
7. Test and replace fuses.
8. Replace light bulbs.
9. Replace flasher units.
10. Remove and replace stop-light switch.
11. Adjust, back-up light switches.
12. Adjust headlights.

7. Replace and adjust distributor.
8. Repair or replace switches.
9. Remove and repair windshield wiper mechanisms or controls.
10. Remove and replace fuse box assembly.
11. Replace chassis and under-hood wiring.
12. Test and rewire dash units.
13. Analyze cause of electrical malfunction.

3. Inspect and test secondary circuit leads, plug wires, distributor cap, and rotor.
4. Inspect ignition switch, resistor, wiring, coil, points, and condenser of the primary circuit.
5. Locate and repair shorts and and open circuits in wiring.
6. Tests, repairs or of Transistor ignition systems.
7. Perform complete engine tune-up.
8. Overhaul Distributor.

## 8A. DRIVE TRAIN

(15 hours)

Interprets basic information concerning standard and automatic transmissions, differentials, clutches, and universal joints. Able to:

1. Check fluid levels in standard transmission.
2. Select fluids for proper application.
3. Inspect universal joints for wear or damage.
4. Lubricate U-joints.
5. Lubricate speedmeter cable drive gear and housing.
6. Check fluid level in automatic transmission and fill to proper level.

## 8B. DRIVE TRAIN WITH MANUAL TRANSMISSION MAINTENANCE AND REPAIR

(15 hours)
(Level I plus 15 hrs. = 30 hrs.)

Inspects, adjusts, services, repairs or replaces the components of the automotive drive train with a manual transmission; according to manufacturer's specifications and to meet minimum industry performance standards.

Level II is a continuation of Level I. Gains knowledge and skills necessary to diagnose drive train problems. Able to:

1. Adjust a clutch.
2. Repair or replace slip-joints or U-joints.
3. Replace manual transmission gaskets and seals (in-car repairs).
4. Replace pilot bearings.
5. Replace throwout bearings.
6. Replace transmission mounts.
7. Adjust mechanical-type clutch.

## 8C. AUTOMATIC TRANSMISSION MAINTENANCE AND REPAIR

(195 hours)
(Level II plus 195 hrs. = 225 hrs.)

Inspects, services, maintains, adjusts, repairs, or replaces the automotive automatic transmission; according to manufacturer's specifications and to meet minimum industry performance standards.

Level III gains knowledge and diagnosis, overhaul, and replacement of clutches, standard and automatic transmissions, transaxles, and differentials (both standard and limited slip). Able to:

1. Replace clutch.
2. Overhaul automatic transmissions.
3. Overhaul transaxles.
4. Overhaul standard and limited slip differentials.
5. Diagnose transmission problems.
6. Adjust floor linkage.
7. Adjust linkage from steering column to automatic transmission.
8. Adjust linkage from engine to automatic transmission.
9. Clean and visually inspect transmission.
10. Replace or adjust modulators.
11. Service filter.

8. Adjust external shift linkage on manual transmissions.

LEVEL II AND LEVEL III MAY OVERLAP

9. Replace a manual transmission.
10. Rebuild manual transmission (major repairs).
11. Replace rear-axle shaft, bearings and seal.
12. Replace pinion seal.
13. Replace differentials.

12. Replace or adjust neutral switch.
13. Make bands adjustments.
14. Remove and install automatic transmission.
15. Replace external seals, gaskets, and lines on automatic transmissions.
16. Inspect, remove, and replace converter.
17. Perform operational automatic transmission inspections.

9. WHEELS AND TIRES

(30 hours)

Interprets basic fundamentals of tires and wheels, including repair and replacement procedures. Able to:

1. Remove and replace tire, tube, and rim assembly.
2. Repair flat tires.
3. Recognize both causes and remedies of abnormal tire wear.

(20 hours)
(Level I plus 20 hrs. = 50 hrs.)

Level II is a continuation of Level I. Able to:

1. Perform front wheel bearing services, remove, clean, lubricate, replace, and adjust.
2. Diagnose tire and wheel malfunctions.
3. Balance wheels and tires.

(50 hours)

Develops additional skills on wheels and tires--wheel alignment in particular.

Training overlaps with Steering and Suspension, Curriculum Level III.

## 10. STEERING AND SUSPENSION (FRONT END MAINTENANCE AND REPAIR)

Perform inspections, maintain, adjust, repair, or replace, the components of the automobile steering front end, and suspension systems; according to manufacturer's specifications and to meet minimum industry performance standards.

(15 hours)

Identifies and performs routine maintenance operations on manual and power steering assemblies. Able to:

1. Lubricate front and rear suspension.
2. Replace belts and adjust tension.
3. Check and correct power steering fluid levels and belt tension.
4. Lubricate ball joints.

(45 hours)
(Level I plus 45 hrs. = 60 hrs.)

Level II is a continuation of the knowledges and skills developed in Level I. Knowledge and skill in minor steering component replacement is gained and introductory knowledge concerning the theory of suspension geometry is gained. Able to:

1. Replace tie rod ends.
2. Replace idler arm.
3. Replace shock absorbers.
4. Perform visual inspections of suspension systems.
5. Inspect and service front wheel bearings grease seal.
6. Inspect steering linkage.

(45 hours)
(Level II plus 45 hrs. = 105 hrs.)

Level III is a continuation of the knowledges and skills developed in Levels I and II. Knowledges and skills are gained in training in steering and suspension components. Able to:

1. Diagnose steering and suspension problems.
2. Perform caster, camber, and toe-in adjustments to manufacturers specifications.
3. Replace ball joints, coil springs, leaf springs, upper and lower control arms, rod ends, and bushings.
4. Adjust worm and sector in steering gear.
5. Repair or replace manual steering components.
6. Replace power steering components.
7. Repair tilt and telescoping steering wheel.

8. Inspect front suspension systems.
9. Replace pivot points on steering linkage.
10. Rebush king pins or link pins.
11. Replace ball joints.
12. Replace front suspension control arms and bushings.
13. Adjust or replace torsion and trunnion bars.
14. Balance wheels and tires.
15. Inspect and replace steering spindles.
16. Inspect and align front end.
17. Inspect and align rear end.

## 11. BRAKING SYSTEM MAINTENANCE AND REPAIR

Perform inspections, adjustments, repairs, and replacements of components of the automotive braking system; according to manufacturer's specifications and to meet minimum industry performance standards.

(15 hours)

Gains knowledge of brake system fundamentals. Able to:

1. Identify types and grades of brake fluids.
2. Check master cylinder fluid unit and fill to proper levels.
3. Inspect brake lines for condition and leaks.
4. Inspect parking brake operation.

(50 hours)
(Level I plus 50 hrs. = 65 hrs.)

Level II is a continuation of the skills and knowledges gained in

1. Adjust service brakes.
2. Adjust hand brake linkage.
3. Inspect brake pedal height and perform required adjustments.
4. Free up parking brake cables.
5. Replace hand brake linkage.
6. Bleed hydraulic brakes.
7. Adjust hand brake linkage and external band.

(20 hours)
(Level II plus 20 hrs. = 85 hrs.)

Level III continues the learning process of Levels I and II. Knowledge and skills for total brake system diagnosis and repair is gained. Able to:

1. Diagnose brake system problems.
2. Service brake warning system.
3. Service brake metering valve.
4. Inspect, repair or replace self-adjusters.
5. Replace brake hoses and lines.
6. Inspect and replace brake pads (disc brakes).
7. Inspect and replace brake shoes.
8. Inspect and turn rotor disc brakes.
9. Inspect and refinish brake drums.
10. Radius grind brake shoes (minor use).
11. Inspect, repair, or replace wheel cylinder.
12. Repair or replace master cylinder.
13. Repair or replace hydraulic power brake component.
14. Perform operational brake inspections.

## 12. AUTOMOTIVE SERVICING

Inspecting, testing, adjusting, repairing, and replacing components in the processing of "Troubleshooting" automotive systems.

| Level I | Level II | Level III |
| --- | --- | --- |
| ------------ ------------- ------------ | Introductory skills gained. | Advanced and specialized skills developed.<br>"Diagnosing and Troubleshooting." |

Standards for Vocational Automotive Service Instruction, Detroit, MI: Motor Vehicle Manufacturers Association of the United States, Inc., 1979.

## 13. DIESEL ENGINE THEORY AND SERVICING THE DIESEL FUEL INJECTION SYSTEM (OPTIONAL)

Level I
( hours)

The diesel engine may be introduced during the orientation to the internal combustion engine.

Level II
( hours)

Upon completion of theory-orientation, graduate is able to:

1. Identify similarities and differences between conventional spark-ignition engine and a diesel engine.
2. Identify fuel-injection system and...
3. ...Explain how the speed of the diesel engine is controlled by controlling the amount of fuel injected.
4. Starts, runs, and stops a diesel engine.
5. Locates and uses emergency shut-down levers and controls.
6. Describe the basic safety precautions to take when working on diesel engines.

Level III
( hours)

Upon completion of this performance or orientation training, the graduate will be able to:

1. Describe the basic safety precautions to take when working on diesel fuel-injection systems.
2. Identify a mechanical fuel injection system.
3. Identify electronic fuel injection systems.
4. On electronic fuel-injection systems, identify the ECU, various sensors, and fuel line nozzels.
5. Practical training (OPTIONAL) may continue to include disassembly and reassembly of fuel-injection systems, preventive maintenance scheduling, and limited troubleshooting of diesel systems. (See Task Listings)

## Instructional Times

## Automotive Service Curriculum by Levels

| Subject Matter | Level I Hours | Level I Percent | Level II Hours | Level II Percent | Level III Hours | Level III Percent |
|---|---|---|---|---|---|---|
| Introduction to Automotive Mechanics | 7 | | | | | |
| Safety | 11 | | | | | |
| Career Opportunities | 6 | | | | | |
| Job Performance & Work Attitudes | 4 | | | | | |
| Shop Math | 5 | | | | | |
| Tools & Equipment | 11 | | | | | |
| Fasteners | 2 | | | | | |
| Shop Practices & Procedures | 2 | | | | | |
| Intro. to Automotive Systems | 37 | | | | | |
| Lubrication | 4 | | | | | |
| Auto, Engine Maintenance, Repair, and Overall | 11 | | 20 | | 223 | |
| Fuel System Maintenance & Repair | 4 | | 16 | | 34 | |
| Emission Controls & Exhaust Systems | 7 | | 26 | | | |
| Cooling | 63 | | | | | |
| Heating | 31 | | | | | |
| Air Conditioning | 63 | | | | | |
| Electrical Systems | 25 | | 40 | | 54 | |
| Drive Train | 15 | | 96 | | 57 | |
| Wheels & Tires | 4 | | 10 | | | |
| Steering & Suspension | 5 | | 14 | | 73 | |
| Braking System Maintenance & Repair | 4 | | 20 | | 66 | |
| Automotive Servicing | | | | | | |
| Servicing Diesel Fuel Injection System | | | | | 10 | |
| Totals | 321 | 100.0 | 242 | 100.0 | 517 | 100.0 |

CURRICULUM LEVEL I - 321 Hours
CURRICULUM LEVEL II - 563 Hours (LEVEL I + 242 Hours)
CURRICULUM LEVEL III - 1080 Hours (LEVEL II + 517 Hours)

# AUTOMOTIVE MECHANICS

## STANDARDS

1. All safety recommendations are standard procedures.
2. Follow shop manuals, specifications and equipment operational manuals unless otherwise instructed.
3. Prior to working under the hood of a vehicle, place fender covers on fenders and, on completing work, remove covers and store them properly.

# SAMPLE
# OUTCOME-REFERENCED TESTS

## AUTOMOTIVE MECHANICS

This articulated, performance-based instruction guide is designed to answer three critical questions necessary for quality instruction.

First, what should be taught?

> The objectives of the articulated, performance-based vocational education program are based on extensive task analysis and validation.
>
> The task objectives represent what employers in business and industry say is important for entry level job success.

Second, how should it be taught?

> It should be taught using the latest "state-of-the-art" instuctional technology incorporated into each unit.
>
> Students are taught the knowledges, skills, and attitudes needed for successful and productive employment.

Third, how should students be evaluated?

> Students are evaluated using a validated competency-based approach to determine student proficiency in vocational knowledges and skills.
>
> The minimum standards are those required for successful entry in the next high level of training or for successful employment.

These sample tests are included to illustrate how the student's competency in vocational skills and knowledges may be measured with validity and reliability. In addition, the test samples are included to promote standardization in the evaluation of vocational students in similar programs.

Test items have been constructed solely from the objectives of the vocational program. The statement of the objectives indicate the level of knowledge or skill to be tested. Task force committee participants have attempted to write tests that agree with objectives in the behavior requested, the given conditions, and the desired standards of performance.

NOTE: Unless the test is marked "Revised" or "R," the test items should be considered as field trial editions currently under review and revisions.

Service or performance checklist forms included in this guide represent vendor supplied forms or forms currently used in training.

## AUTOMOTIVE MECHANICS

## SUGGESTED INSTRUCTION TIME

| AUTOMOTIVE MECHANICS UNIT/TASK | | SUGGESTED HOURS |
|---|---|---|
| Unit 1.0 | INTRODUCTION TO AUTOMOTIVE MECHANICS | |
| A.01 | Review School Policies and Procedures | 3 |
| A.02 | Orientation to Shop | 1 |
| A.03 | Review Course Objectives and Standards | 3 |
| 1.0-B | AUTOMOTIVE MECHANICS - SAFETY | |
| B.01 | Classroom Safety | 1 |
| B.02 | Use Personal Protective Equipment | 1 |
| B.03 | Practice Safety in Using Power Tools (and Machinery) | 1 |
| B.04 | Identify Typical Shop Safety Hazards | 3 |
| B.05 | Demonstrate or Interpret Emergency Procedures to Respond to Shop Injuries | 2 |
| B.06 | Demonstrate Fire Safety Precautions and Practices | 3 |
| 1.0-C | CAREER OPPORTUNITIES IN AUTOMOTIVE MECHANICS | |
| C.01 | Identify Typical Automotive Mechanics and Related Career Opportunities | 3 |
| C.02 | Obtaining a Job | 1 |
| C.03 | Identify Technician's Responsibilities Toward the Employers, Customer, and Craft | 1 |
| C.04 | Identify How to Meet People and to be Accepted by Fellow Workers in the Service Field | 1 |
| 1.0-D | JOB PERFORMANCE AND WORK ATTITUDES IN AUTOMOTIVE MECHANICS | |
| D.01 | Job Performance | 2 |
| D.02 | Work Attitudes | 2 |

| | | |
|---|---|---|
| 1.0-E | AUTOMOTIVE MECHANICS - SHOP MATH | |
| E.01 | Basic Math Review - Simple Fractions | 1 |
| E.02 | Basic Math Review - Decimals and Percentages | 1 |
| E.03 | Reading Micrometers | 2 |
| E.04 | Metric Measurements and Equivalents | 1 |
| 1.0-F | AUTOMOTIVE MECHANICS - TOOLS AND EQUIPMENT | |
| F.01 | Identification and use of Common Hand Tools and Measuring Devices | 9 |
| F.02 | Identify and Properly use Common Automotive Shop Machinery | 2 |
| 1.0-G | AUTOMOTIVE MECHANICS - AUTOMOTIVE FASTENERS | |
| G.01 | Identify and use Automotive Fasteners | 2 |
| 1.0-H | AUTOMOTIVE MECHANICS - SHOP PRACTICES AND PROCEDURES | |
| H.01 | Shop Practices and Procedures | 2 |
| 1.0-I | AUTOMOTIVE MECHANICS - INTRODUCTION TO AUTOMOTIVE SYSTEMS | |
| I.01 | Lubrication and Tires | 3 |
| I.02 | Cooling System | 3 |
| I.03 | Braking System | 3 |
| I.04 | Fuel Systems | 3 |
| I.05 | Steering System and Front End | 2 |
| I.06 | Power Train and Manual Transmission | 6 |
| I.07 | Engine | 6 |
| I.08 | Heater System | 2 |
| I.09 | Automatic Transmission | 2 |
| I.10 | Electrical System | 6 |
| I.11 | Air Conditioners | 1 |
| TOTAL HOURS | | 85 |

## UNIT 2.0 LUBRICATION AND VEHICLE OPERATING MAINTENANCE

| | | |
|---|---|---|
| 2.01 | Draining and Refill Engine Oil | 1 |
| 2.02 | Change Oil Filter Cartridge | 1 |
| 2.03 | Chassis Lubrication | 1 |
| 2.04 | Inspect, Service, or Replace Carburetor Air Cleaner | 1 |
| TOTAL HOURS | | 4 |

## Unit 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

| | | |
|---|---|---|
| 3.01 | Diagnose Needed Engine Service or Repair | 1 |
| 3.02 | Perform Engine Vacuum Tests and Determine Needed Repairs | 1 |
| 3.03 | Replace Valve Cover Gaskets | 5 |
| 3.04 | Replace Outside Seals | 4 |
| 3.05 | Replace Motor Mounts | 8 |
| 3.06 | Perform Cylinder Compression Tests and Determine Needed Repairs | 2 |
| 3.07 | Remove Cylinder Head(s) From Engine | 12 |
| 3.08 | Disassembling a Cylinder Head | 3 |
| 3.09 | Inspect Valve Spring Retainers and Locks | 2 |
| 3.10 | Inspect Valve Guides for Wear, Check Valve Guide to Stem Fit, and Determine Needed Repairs | 1 |
| 3.11 | Inspect Cylinder Heads for Cracks, Gasket Surface Area for Warpage, and Check Passage Condition | 3 |
| 3.12 | Reassembling Valve Components With Head | 2 |
| 3.13 | Installing Cylinder Heads on Engine Block | 6 |
| 3.14 | Steam Clean Engine | 4 |
| 3.15 | Inspect Exhaust System | 2 |
| 3.16 | Replace Exhaust Manifold(s) | 12 |
| 3.17 | Testing a Positive Crankcase Ventilation System | 2 |
| 3.18 | Perform Cylinder Leakage Tests and Determine Needed Repairs | 3 |

| | | |
|---|---|---|
| 3.19 | Perform Cylinder Power Balance Tests and Determine Needed Repairs | 1 |
| 3.20 | Diagnose Valve Train and Head Malfunctions | 6 |
| 3.21 | Clean Engine Parts and Check for Condition | 6 |
| 3.22 | Perform Operational Inspections of the Engine Lubrication Systems | 4 |
| 3.23 | Replace Camshaft, Replace Camshaft Bearings, Replace Timing Gears and Chains, Replace Gaskets and Seals, Replace Valve Lifters | 18 |
| 3.24 | Repair and Replace Intake Manifold and Gaskets | 8 |
| 3.25 | Adjust Valves | 6 |
| 3.26 | Inspect, Replace and/or Grind Valve Face and Stem | 4 |
| 3.27 | Refacing Valve Seats | 4 |
| 3.28 | Knurl Valve Guide | 4 |
| 3.29 | Remove and Replace Oil Pump | 16 |
| 3.30 | Replace Flywheel and Flywheel Ring Gear | 8 |
| 3.31 | Remove and Replace Engine From Vehicle | 33 |
| 3.32 | Remove and Replace Connecting Rods and Bearings, Remove and Replace Pistons and Rings, and Inspect Parts with Micrometers and Plastigauge | 32 |
| 3.33 | Remove and Replace Crankshaft and Bearings, Inspect With Micrometers and Plastigauge for Proper Bearing Fit | 31 |
| TOTAL HOURS | | 254 |
| Unti 4.0 | FUEL SYSTEM MAINTENANCE AND REPAIR | |
| 4.01 | Replace a Fuel Filter | 2 |
| 4.02 | Repairs or Services Carburetors | 12 |
| 4.03 | Adjust Carburetor | 2 |
| 4.04 | Inspects, Cleans, and Adjusts Choke Unit (Automatic and Manual) | 2 |
| 4.05 | Install Carburetor | 3 |

| | | |
|---|---|---|
| 4.06 | Removes, Services, or Replaces Fuel Lines and Hoses | 4 |
| 4.07 | Inspect and Measures Fuel Flow and Pressure of System | 2 |
| 4.08 | Replace Fuel Pump | 4 |
| 4.09 | Adjust Fuel Injection System | * |
| 4.10 | Inspects, Services, or Replaces Fuel Sending Unit | 4 |
| 4.11 | Analyze for Moisture or Foreign Particles in Fuel Tank | 4 |
| 4.12 | Diagnose and Repair Fuel System Malfunctions | 3 |
| 4.13 | Rebuild Carburetor | 12 |
| TOTAL HOURS | | 54 |
| Unit 5.0 | EMISSION CONTROLS AND EXHAUST SYSTEM | |
| 5.01 | Service PCV System | 3 |
| 5.02 | Inspect Exhaust System for Leaks or Damage | 4 |
| 5.03 | Test and Adjust Idle Solenoid | 2 |
| 5.04 | Check and Service Fuel Evaporation System (Fuel-Vapor System) | 2 |
| 5.05 | Service, Repair, or Replace Thermostatic Air Cleaner | 2 |
| 5.06 | Test Air Injection Reactor System | 4 |
| 5.07 | Test and Service Exhaust Gas Recirculation Valve Operation | 5 |
| 5.08 | Inspect and Service Manifold Heat Control Valve | 4 |
| 5.09 | Remove and Replace Catalytic Converter | 3 |
| 5.10 | Inspects, Removes, and Replaces Tail Pipe or Muffler | 4 |
| TOTAL HOURS | | 33 |
| Unit 6.0 | COOLING SYSTEM MAINTENANCE AND REPAIR | |
| 6.01 A | Check and Correct Coolant Level | 2 |
| 6.02 A | Inspect, Adjust, or Replace Fan Belts | 2 |

| | | |
|---|---|---|
| 6.03 A | Check and Test Radiator Cap | 2 |
| 6.04 A | Test the Cooling System Thermostat | 6 |
| 6.05 A | Pressure Test Cooling System | 4 |
| 6.06 A | Inspect and Replace Water Hoses | 2 |
| 6.07 A | Check Coolant Freezing Point | 1 |
| 6.08 A | Check Overflow Tank | 1 |
| 6.09 A | Remove and Install Radiators | 8 |
| 6.10 A | Chemically Clean and Flush Cooling System | 8 |
| 6.11 A | Perform Chemical Test or Coolant System | 1 |
| 6.12 A | Replace Water Pump | 16 |
| 6.13 A | Replace Variable Speed Fan | 4 |
| 6.14 A | Replace Core (Freeze) Plugs | 6 |
| 6.0-B | AUTOMOBILE HEATER MAINTENANCE AND REPAIR | |
| 6.01 B | Reverse Flush Heater System (Core) | 6 |
| 6.02 B | Replace Defroster Hose | 6 |
| 6.03 B | Replace Heater Control Units | 4 |
| 6.04 B | Remove and Replace Water Heater Core | 12 |
| 6.05 B | Diagnose Heating System Malfunctions | 3 |
| 6.0-C | AUTOMOTIVE AIR CONDITIONER MAINTENANCE AND REPAIR | |
| 6.01 C | Check Air Conditioner for Satisfactory Operation | 2 |
| 6.02 C | Discharge Air Conditioning System | 2 |
| 6.03 C | Replace Fan Motor | 10 |
| 6.04 C | Replace Drier in AC System | 6 |
| 6.05 C | Replace Expansion Valve in AC Unit | 6 |
| 6.06 C | Replace Compressor Seals | 6 |
| 6.07 C | Replace Condenser Assembly in Air Conditioning Unit | 6 |

|  |  |  |
|---|---|---|
| 6.08 C | Replace POA Valve in AC Unit | 6 |
| 6.09 C | Replace Air Conditioner Compressor | 6 |
| 6.10 C | Pressure Test and Leak Test AC System | 3 |
| 6.11 C | Diagnose Air Conditioning Malfunctions | 2 |
| 6.12 C | Repair AC Electrical Circuits | 2 |
| 6.13 C | Repair Vacuum Circuits | 2 |
| 6.14 C | Inspect and Recharge Air Conditioning System with Refrigerant | 2 |
| 6.15 C | Evacuate AC System | 2 |
| TOTAL HOURS |  | 157 |
| Unit 7.0 | ELECTRICAL IGNITIONS SYSTEMS |  |
| 7.01 | Check Spark Plugs and Replace as Needed | 3 |
| 7.02 | Check Spark Plug Wiring | 3 |
| 7.03 | Clean and Replace Distributor Cap Towers, Wiring, and Other Minor Electrical Units | 6 |
| 7.04 | Inspect, Adjust, Remove, and Replace Alternator Belt | 2 |
| 7.05 | Test, Service, or Replace Batteries, Cables, and Battery Boxes | 6 |
| 7.06 | Perform Operational Inspection of Lighting Systems: Replace Bulbs, Flashers, and Fuses as Necessary | 1 |
| 7.07 | Test and Replace Fuses | 1 |
| 7.08 | Replace Flasher Units | 1 |
| 7.09 | Adjust Backup Light Switches | 1 |
| 7.10 | Adjust Headlights | 1 |
| 7.11 | Set Ignition Timing | 2 |
| 7.12 | Replace Alternators | 3 |
| 7.13 | Replace Starters | 6 |
| 7.14 | Replace Starter Solenoid | 7 |

| | | |
|---|---|---|
| 7.15 | Repair Alternators | 8 |
| 7.16 | Analyze Malfunctions in the Cranking System | 2 |
| 7.17 | Replace and Adjust Distributors | 4 |
| 7.18 | Repair or Replace Switches | 2 |
| 7.19 | Repair Windshield Wiper Mechanisms and Controls | 4 |
| 7.20 | Repair or Replace Fuse Box Assembly | 2 |
| 7.21 | Replace Chassis and Underhood Wiring | * |
| 7.22 | Test and Rewire Dash Units | * |
| 7.23 | Analyze Cause of Electrical Malfunction | 4 |
| 7.24 | Replace Ignition Switch and Resistor | 4 |
| 7.25 | Evaluate Alternator and Regulator Output | 2 |
| 7.26 | Repair or Replace Charging System Regulator | 8 |
| 7.27 | Analyze or Adjust Engine Performance Using Engine Analyzer | 3 |
| 7.28 | Strobe Distributor and Modify/Correct Advance Curves | 8 |
| 7.29 | Inspect Secondary Circuit Lead Wires, Distributor Cap, and Rotor, and Measure Secondary Wire Resistance | 2 |
| 7.30 | Inspect Ignition Switch, Resistor, Wiring, and Coil or the Primary Circuit | 2 |
| 7.31 | Replace Coil of the Primary Circuit | 2 |
| 7.32 | Locate and Repair Shorts and Open Circuits in Wiring | * |
| 7.33 | Test and Repair Transistor Ignition Systems | 4 |
| 7.34 | Inspect Points and Condenser of Primary Circuit | 1 |
| 7.35 | Replace Points and Condenser (Tune-up) | 2 |
| 7.36 | Overhaul Distributor | 4 |
| 7.37 | Perform Complete Engine Tune-up | 8 |
| TOTAL HOURS | | 111 |

### Unit 8.0 DRIVE TRAIN - LEVEL I

| | | |
|---|---|---|
| 8.01 A | Check Fluid Levels in Standard Transmission | 1 |
| 8.02 A | Check Fluid Levels in Automatic Transmission and Fill to Proper Level | 1 |
| 8.03 A | Select Fluid for Proper Application (Lubricate) | 3 |
| 8.04 A | Inspect Universal Joints for Wear or Damage | 6 |
| 8.05 A | Lubricate U-Joints | 2 |
| 8.06 A | Lubricate Speedometer Cable Drive Gear and Housing | 2 |

### Unit 8.0 DRIVE TRAIN - LEVEL II

| | | |
|---|---|---|
| 8.01 B | Adjust a Clutch | 2 |
| 8.02 B | Repair and Replace Slip-Joints, U-Joints | 4 |
| 8.03 B | Repair, Replace, or Adjust Front Drive Axle Assemblies | 16 |
| 8.04 B | Replace Manual Transmission Rear Seal, Gasket, and Bushing (In Car Repairs) | 4 |
| 8.05 B | Remove and Replace Clutch, Disc Pressure Plate, Release (Throwout) Bearings, Pilot Bearings (Bushing), and Adjust External Shaft Linkage on Manual Transmission | 4 |
| 8.06 B | Replace Transmission Mounts | 4 |
| 8.07 B | Test Manual Transmission Operation | 2 |
| 8.08 B | Replace Manual Transmission | 6 |
| 8.09 B | Rebuild Manual Transmission | 16 |
| 8.10 B | Replace Rear Axle Shaft, Bearings and Seal | 12 |
| 8.11 B | Replace Pinion Seal | 8 |
| 8.12 B | Diagnose Differential Malfunctions | 2 |
| 8.13 B | Repair or Replace Differential | 16 |

### Unit 8.0 DRIVE TRAIN - LEVEL III

| | | |
|---|---|---|
| 8.01 C | Perform Operational Tests on Automatic Transmission | 2 |
| 8.02 C | Adjust Column-Type Linkage | 2 |

| | | |
|---|---|---|
| 8.03 C | Adjust Floor Linkage | 4 |
| 8.04 C | Adjust Linkage From Engine to Automatic Transmission | 2 |
| 8.05 C | Clean and Visually Inspect Transmission | 4 |
| 8.06 C | Diagnose, Replace, or Adjust Modulators | 2 |
| 8.07 C | Service Filter | 4 |
| 8.08 C | Replace or Adjust Neutral Safety Switch | 3 |
| 8.09 C | Make Band Adjustments (Internal or External) | 6 |
| 8.10 C | Remove and Install Automatic Transmission | 8 |
| 8.11 C | Replace External Seals, Gaskets, and Lines on Automatic Transmission | 4 |
| 8.12 C | Inspect, Remove, and Replace Converter | 4 |
| 8.13 C | Overhaul Automatic Transmission | 12 |
| TOTAL HOURS | | 168 |

Unit 9.0 WHEELS AND TIRES

| | | |
|---|---|---|
| 9.01 | Remove and Replaces Tire, Tube, and Rim Assembly | 1 |
| 9.02 | Repair Flat Tire | 2 |
| 9.03 | Recognize Both Causes and Remedies of Abnormal Tire Wear | 1 |
| 9.04 | Perform Front Wheel Bearing Services, Remove, Clean, Lubricate, Replace, and Adjust | 4 |
| 9.05 | Speed Balance Wheels and Tires | 4 |
| 9.06 | Diagnose Tire and Wheel Malfunctions | 2 |
| TOTAL HOURS | | 14 |

Unit 10.0 STEERING AND SUSPENSION

| | | |
|---|---|---|
| 10.01 | Lubricate Front and Rear Suspension | 2 |
| 10.02 | Replace Belts and Adjust Tension | 1 |
| 10.03 | Check and Correct Power-Steering System Fluid Level and Belt Tension | 2 |
| 10.04 | Inspect Steering Linkage and Ball-Joints | 1 |
| 10.05 | Replace Tie Rod End (Ball Socket) | 1 |

|  |  |  |
|---|---|---|
| 10.06 | Replace Idler Arm | 1 |
| 10.07 | Remove and Replace Shock Absorbers | 2 |
| 10.08 | Remove and Replace McPherson Strut Assembly | 4 |
| 10.09 | Perform Visual Inspections of Suspension System | 1 |
| 10.10 | Inspect and Service Front Wheel Bearing and Grease Seal | 4 |
| 10.11 | Inspect and Diagnose Steering and Front Suspension System Problems | 1 |
| 10.12 | Replace Coil Springs | 6 |
| 10.13 | Remove and Replace Leaf Springs | 6 |
| 10.14 | Adjust Worm and Sector in Steering Gear | 2 |
| 10.15 | Repair or Replace Manual Steering Components | 10 |
| 10.16 | Replace Power Steering Components | 1 |
| 10.17 | Repair Tilt and Telescoping Steering Wheel | 4 |
| 10.18 | Inspect Front Suspension System | 4 |
| 10.19 | Rebush King Pins | 4 |
| 10.20 | Replace Ball Joints | 6 |
| 10.21 | Replace Front Suspension Control Arms and Bushings | 10 |
| 10.22 A | Adjust Torsion Bars | 2 |
| 10.22 B | Replace Torsion Bars | 6 |
| 10.23 | Balance Wheels and Tires | 2 |
| 10.24 | Remove and Replace Steering Spindle (Ball Joint Type) | 4 |
| 10.25 | Inspect and Align Front End | 4 |
| 10.26 | Inspect and Service Rear End | 1 |
| TOTAL HOURS |  | 92 |

## Unit 11.0 BRAKING SYSTEM MAINTENANCE AND REPAIR

| | | |
|---|---|---|
| 11.01 | Identify Types and Grades or Brake Fluid | ½ |
| 11.02 | Check Brake Master Cylinder Fluid and Fill to Proper Levels | ½ |
| 11.03 | Inspect Brake Lines For Condition and Leaks | 3 |
| 11.04 | Inspect Parking Brake Operation | 1 |
| 11.05 | Adjust Service Brakes (Non self-Adjusting) | 2 |
| 11.06 A | Adjust Hand Brake Linkage | 1 |
| 11.06 B | Adjust External Band | 2 |
| 11.07 | Inspect Brake Pedal Height and Perform Required Adjustments | 1 |
| 11.08 | Replace Hand Brake Linkage | 10 |
| 11.09 | Bleed Hydraulic Brakes (Manual) | 3 |
| 11.10 | Diagnose Brake System Problems | 4 |
| 11.11 | Service Brake Warning System | 2 |
| 11.12 | Inspect and Replace Brake Metering Valve | 3 |
| 11.13 | Inspect, Repair, or Replace Self-adjusters | 3 |
| 11.14 | Replace Brake Hoses and Lines | 3 |
| 11.15 A | Inspect and Replace Brake Pads (Disc Brakes) | 3 |
| 11.15 B | Repair Disc Brake Calipers | 5 |
| 11.16 | Inspect and Replace Brake Shoes | 5 |
| 11.17 | Inspect and Turn Rotor on Disc Brakes | 6 |
| 11.18 | Inspect and Refinish Brake Drums | 4 |
| 11.19 | Radius Grind Brake Shoes | 6 |
| 11.20 | Inspect, Repair, or Replace Wheel Cylinder | 10 |
| 11.21 A | Remove or Replace Master Cylinder | 2 |
| 11.21 B | Repair Cylinder | 2 |

| | | |
|---|---|---|
| 11.22 | Repair or Replace Hydraulic Power Brake Components | 4 |
| 11.23 | Perform Operational Brake Inspection | 4 |
| TOTAL HOURS | | 90 |
| Unit 12.0 | AUTOMOTIVE SERVICING | |
| 12.0 | Service or Repair Automobiles | ** |
| Unit 13.0 | SERVICING DIESEL FUEL INJECTION SYSTEM | |
| 13.01 | Adjust Engine Idle | 1 |
| 13.02 | Bleed Fuel System | 2 |
| 13.03 | Clean Injector | 2 |
| 13.04 | Replace Fuel Injector | 1 |
| 13.05 | Install and Time Fuel Injection Pump | 4 |
| TOTAL HOURS | | 10 |
| TOTAL HOURS | | 1080 |

# TASK LISTINGS
## AUTOMOTIVE MECHANICS

| UNIT/TASK | DESCRIPTION |
|---|---|
| 1.0-A | INTRODUCTION TO AUTOMOTIVE MECHANICS |
| A.01 | (Review School Policies and Procedures) Given information on school policies and procedures, apply these policies and procedures on a day-to-day basis. |
| A.02 | (Orientation to Shop) Given information on school shop or instructor's policies and procedures, apply these policies and procedures. The policies and procedures will be adhered to on a day-to-day basis. Meet standards of the instructor 100 percent. |
| A.03 | (Review Course Objectives and Standards) Given an introduction to the automotive mechanics program, a review of the course objectives, and minimum standards of performance; describe the course objectives and the minimum performance expected to demonstrate competency in the objective. |
| 1.0-B | AUTOMOTIVE MECHANICS - SAFETY |
| B.01 | (Classroom Safety) Given a typical automotive mechanics shop or job situation, exhibit an awareness of safety practices, safe work habits, and a positive attitude concerning job safety and accident prevention and meet standards established by the instructor. |
| B.02 | (Use Personal Protective Equipment) Given personal protection equipment guidelines, personal protection equipment, and a working situation, use personal protection equipment to meet the instructor's standards or other applicable standards such as OSHA. |
| B.03 | (Practice Safety in Using Power Tools /and Machinery/) Given proper instructions, power tools used in automotive servicing, use power tools safely according to manufacturer's specifications/ instructions and meet instructor's standards (or local codes, OSHA Standards). |
| B.04 | (Identify Typical Shop Safety Hazards) Given proper instruction, orientation to OSHA safety requirements, and introduction to a typical shop hazards; identify safety practices or safety hazards that violate OSHA Standard's or instructor's standards. |
| B.05 | (Demonstrate or Interpret Emergency Procedures to Respond to Shop Injuries) Given proper instruction concerning shop hazards, emergency first aid procedures for handling injuries, and a simulated situations; demonstrate or interpret how to |

perform first aid for possible shop injuries according to acceptable first aid techniques.

B.06 (Demonstrate Fire Safety Precautions and Practices) Given instruction, orientation to different types of fires and fire extinguishing equipment, and simulated situations; explain typical steps to take when experiencing a fire; how to extinguish small fires to include class A, B, and C fires; and operation of typical fire extinguishing equipment.

## 1.0-C CAREER OPPORTUNITIES IN AUTOMOTIVE MECHANICS

C.01 (Identify Typical Automotive Mechanics and Related Career Opportunities) Given instruction, data on the local automotive service industry, primarily auto mechanics and opportunities to study the auto service and related industry; identify the major categories of potential employers in the local community (and the key characteristics of each).

C.02 (Obtaining a Job) Given proper orientation concerning the automotive service industry, describe how to get a job and hold it to the instructor's standards (or standards of the guidance or placement office).

C.03 (Identify Technician's Responsibilities Toward the Employers, Customer, and Craft) Given instruction concerning the automotive mechanics responsibilities toward the employer, customer, and craft; interpret and demonstrate in practical training the attitudes and performance standards that the local automotive service industry (or instructor) expects from the graduate toward the employer, customer, and craft.

C.04 (Identify How to Meet People and to be Accepted by Fellow Workers in the Service Field) Given a proper orientation concerning how to meet people and to be accepted by fellow workers in the automotive service field, identify the proper activities and attitudes to make a good impression with people and to be accepted by fellow workers, 80 percent accuracy on written knowledge tests and must be instructor's standards in demonstrated performance.

## 1.0-D JOB PERFORMANCE AND WORK ATTITUDES IN AUTOMOTIVE MECHANICS

D.01 (Job Performance) Given instruction, demonstrate job performance characteristics that are considered important to entry-level career success in the vocational field. A "Job Performance Rating Sheet" will be used to evaluate performance and all items must be rated "frequently" or above.

D.02 (Work Attitudes) Given instruction, demonstrate work attitudes that the majority of potential employers prefer in an entry-level worker. Performance will be evaluated on a "Work Attitudes

Score Card" and a minimum of 90 percent should be attained. Performance will be rated through training and should improve to 100 percent by the end of the training period.

## 1.0-E AUTOMOTIVE MECHANICS - SHOP MATH

E.01 (Basic Math Review - Simple Fractions) Given a pretest or examples by the instructor, conduct the following operations with fractions: (1) Change any fraction to a decimal number, and any terminating decimal number to a fraction. (2) Arrange in order... unit and simple nonunit fractions. (3) Write equivalent fractions in higher, lower, and lowest terms. (4) Write improper fractions as whole or mixed numbers, and mixed numbers as improper fractions. (5) Multiply fractions and mixed numbers, expressing answers in simplest form. (6) Divide fractions and mixed numbers, expressing answers in simplest form. (7) Add and subtract unlike fractions, expressing answers in simplest form. (8) Add and subtract mixed numbers with unlike fractions, expressing answers in simplest form. (9) Use rational numbers to solve simple work problems.

E.02 (Basic Math Review - Decimals and Percentages) Given a pretest or examples by the instructor, conduct the following decimal math operations: (1) Name the place value of digits in decimal numbers of up to three digits before the decimal and three digits after the decimal. (2) Compare decimal numbers and arrange them in order. (3) Write the numeral for any decimal number of up to three decimal places. (4) Round decimal numbers to any designated place value up to thousandths. (5) Add and subtract decimal numbers of up to three digits. (6) Multiply decimal numbers by whole numbers or decimal numbers. (7) Divide a number by a three digit decimal number. (8) Multiply and divide decimal numbers by powers of ten, by inspection.

E.03 (Reading Micrometers) Given instruction, a micrometer (typical to automotive mechanics work), and a practical exercise; identify the parts of the micrometer, explain how to hold the micrometer when using it, demonstrate how to read the micrometer, and given accurate readings from a micrometer drawing showing gauge settings.

E.04 (Metric Measurements and Equivalents) Given instruction in the metric system of measurements and conversion from United States Customary units to metric; read and convert dimensions from one system into the other on instructor provided problems. Accuracy should be 100 percent.

## 1.0-F AUTOMOTIVE MECHANICS - TOOLS AND EQUIPMENT

F.01 (Identification and Use of Common Hand Tools and Measuring Devices) Given proper instruction concerning the identification, use, and care of automotive shop tools and measuring devices, selected tools and measuring devices; identify, state the use of, and demonstrate how to use the tools and measuring devices meeting instructor's standards.

F.02 (Identify and Properly Use Common Automotive Shop Machinery) Given proper instruction, typical automotive shop machinery, and situations in which such machinery might be employed; state the purpose of given items of shop machinery with 80 percent accuracy and demonstrate the proper use of the machinery with 90 percent accuracy.

### 1.0-G AUTOMOTIVE MECHANICS - AUTOMOTIVE FASTENERS

G.01 (Identify and Use Automotive Fasteners) Given proper instruction, various fasteners used in automotive mechanics, and job situations requiring the use of fasteners; identify, by the proper terminology, the appropriate fasteners for the job and use the fastener properly, meeting manufacturer's specifications and instructor's standards.

### 1.0-H AUTOMOTIVE MECHANICS - SHOP PRACTICES AND PROCEDURES

H.01 (Shop Practices and Procedures) Given proper instruction concerning standard shop operating procedures, appropriate reference materials, and simulated or typical job situations; choose and use related technical information, such as shop manuals, flat rate manual, manufacturer's specifications, and parts catalogs, using the proper terminology and parts requisition forms to the instructor's standards.

### 1.0-I AUTOMOTIVE MECHANICS - INTRODUCTION TO AUTOMOTIVE SYSTEMS

I.01 (Lubrication and Tires) Given proper instruction, identify types, purpose, use and operator care of lubrication items and tires.

I.02 (Cooling System) Given proper instruction concerning the operation of the cooling system, identify the purpose of the cooling system, major components and purposes, and perform operator care of cooling system to manufacturer's specifications or to instructor's standards.

I.03 (Braking System) Given proper instruction concerning automotive braking systems, identify the purpose, operation, major parts of a braking system, and perform operator care of a given braking system.

I.04 (Fuel Systems) Given proper instruction, samples of selected major american and foreign automobiles, state the purposes and describe the operation of the fuel system. Identify major parts and identify their purposes; state the types and characteristics of motor fuels; and perform operator maintenance on fuel systems.

I.05 (Steering System and Front End) Given proper instruction to the automotive steering system and front end, state the purpose and describe the operations of the automotive steering systems and front end. Identify and state the purpose of major component parts of the steering system and front end; and demonstrate how to correctly perform operator maintenance, meeting the manufacturer's specifications and the instructor's standards.

I.06 (Power Train and Manual Transmission) Given proper instruction, orientation to different automobile makes with manual transmissions, identify purposes, operation, and major parts of the power train system with manual transmission and perform operator maintenance meeting manufacturer's specifications and instructor's standards.

I.07 (Engine) Given proper instructions and an orientation to the automotive gas engine, state the purpose and describe the operation of the engine, identify the major component parts and state their purposes, and demonstrate how to perform operator maintenance according to manufacturer's specifications and meeting the instructor's standards.

I.08 (Heater System) Given a proper orientation, a typical automobile and shop situation to service a heater system, state the purpose and operation of the automotive heater system identify major component parts and state their purpose, and perform operator maintenance on the heater to 90 percent accuracy.

I.09 (Automatic Transmission) Given an orientation to the automobile automatic transmission, introduction to typical automatic transmissions, and operator maintenance of transmissions; state purpose and describe operation of the automatic transmission, identify and state the purpose of major component parts, and show how to perform operator maintenance.

I.10 (Electrical System) Given proper orientation to the automotive electrical system, state the purpose and describe the operation of the automobile electrical system, identify and state the purpose of major component parts, and show how to perform operator maintenance.

I.11 (Air Conditioners) Given an orientation to the automobile air conditioning system, typical manufacturer systems, state the purpose and describe the operation of the automobile air conditioner, identify and state the purpose of major component parts of the air conditioner, and show how to perform operator maintenance.

# UNIT 1.0

# INTRODUCTION TO AUTOMOTIVE MECHANICS

A. INTRODUCTION

B. SAFETY

C. CAREER OPPORTUNITIES

D. JOB PERFORMANCE AND WORK ATTITUDES

E. SHOP MATH

F. TOOLS AND EQUIPMENT

G. AUTOMOTIVE FASTENERS

H. SHOP PRACTICES AND PROCEDURES

I. INTRODUCTION TO AUTOMOTIVE SYSTEMS

## UNIT 1.0-A

## INTRODUCTION TO AUTOMOTIVE MECHANICS

UNIT 1.0-A INTRODUCTION TO AUTOMOTIVE MECHANICS

TASK A.01 REVIEW SCHOOL POLICIES AND PROCEDURES

---

PERFORMANCE OBJECTIVE:

Given information on school policies and procedures, apply these policies and procedures on a day-to-day basis.

PERFORMANCE ACTIONS:

A.0101 Review school policies and procedures.

A.0102 Review philosophy of school and state.

A.0103 Review relevant safety policies and procedures under unit concerning safety and practice good safety behavior.

PERFORMANCE STANDARDS:

- Using information and materials, supplies, review and apply school policies and procedures daily.

SUGGESTED INSTRUCTION TIME: 3 Hours

RELATED TECHNICAL INFORMATION:

- Student Handbook.
- Authorization and "release" forms (such as safety release).
- Written Policies and Procedures of the School District.

UNIT 1.0-A INTRODUCTION TO AUTOMOTIVE MECHANICS

TASK A.02 ORIENTATION TO SHOP

---

PERFORMANCE OBJECTIVE:

Given information on school shop or instructor's policies and procedures, apply these policies and procedures. The policies and procedures will be adhered to on a dayto-day basis. Meet standards of the instructor 100 percent.

PERFORMANCE ACTIONS:

A.0201 Review with instructor the shop policies and procedures.

A.0202 Apply, with 100 percent accuracy, the policies and procedures of the shop.

PERFORMANCE STANDARDS:

- Apply information/instructions given during orientation and throughout training period to comply with all policies and procedures of the shop (instructor) on a day-to-day basis.
- Standards of the State, School District, Vocational Center or high school, and instructor apply.

SUGGESTED INSTRUCTION TIME: 1 Hour

RECOMMENDED:

- Shop Policies and Procedures should be written and posted or distributed to students.

UNIT 1.0-A INTRODUCTION TO AUTOMOTIVE MECHANICS

TASK A.03 REVIEW COURSE OBJECTIVES AND STANDARDS

---

PERFORMANCE OBJECTIVE:

Given an introduction to the automotive mechanics program, a review of the course objectives and minimum standards of performance; describe the course objectives, and the minimum performance expected to demonstrate competency in the objective.

(NOTE: This task may be accomplished in general at the beginning of the first year and in detail over the two year training period.)

Possible Action: Instructor may require students to identify objectives and standards as the initiation of each new unit of instruction.

PERFORMANCE ACTIONS:

A.0301 Review each major objective of the automotive mechanics program.

A.0302 Review the minimum performance standards of the objectives.

PERFORMANCE STANDARDS:

- Using information provided, explain the objectives of the course and describe the minimum performance for each objective.

SUGGESTED INSTRUCTION TIME: 3 Hours

RECOMMENDED:

- Course objectives, such as the Task Listing, should be written and posted or distributed to students.

# UNIT 1.0-B

# AUTOMOTIVE MECHANICS

# SAFETY

UNIT 1.0-B AUTOMOTIVE MECHANICS - SAFETY

TASK B.01 CLASSROOM SAFETY

---

PERFORMANCE OBJECTIVE:

Given a typical automotive mechanics shop or job situation, exhibit an awareness of safety practices, safe work habits, and a positive attitude concerning job safety and accident prevention and meet standards established by the instructor.

PERFORMANCE ACTIONS:

| | |
|---|---|
| B.0101 | Develop an awareness of hazards and become more safety conscious. |
| B.0102 | Develop a serious attitude toward the use of safety procedures. |
| B.0103 | Prepare for safety before entering the work area. |
| B.0104 | Prepare for safety on entering the work area. |
| B.0105 | Prepare for safety at the work station. |
| B.0106 | Demonstrate knowledge of safety color coding. |
| B.0107 | Practice safe procedures. |
| B.0108 | Prepare for safety on leaving the work environment. |

SUGGESTED INSTRUCTION TIME: 1 Hour

PERFORMANCE STANDARDS:

- "Zero-Level" accident record.
- Instructor's standards based on recommended resources.
- Applicable OSHA Standards.

POSSIBLE RESOURCES:

Current vocational program safety guide publication of The School District of Greenville County.

Jacobs, Clinton O., and Howard J. Turner, Developing Shop Safety, Skills, Athens, GA: American Association for Vocational Instructional Materials. Approximately 80 pages of brief, visually clear suggestions concerning a variety of shop safety situations. Good student or resource manual.

RECOMMENDED RESOURCES (Con't.):

Safety Handbook, A Guide for Trade and Industrial Programs, Clemson University, SC: Vocational Education Media Center, 1968. (No. 13/2/70, $2.25; Accompanying 31 Transparencies, No. 9/8/68, $5.75.) Available from Trades and Industries District Supervisors, Office of Vocational Education, South Carolina State Department of Education or from the Vocational Education Media Center, Clemson University, SC.

Planning for Emergencies, Occupational Safety and Health Short Course Number Seven, Columbia, SC: SC State Board for Technical and Comprehensive Education.

Notgrass, Troy. Safety Handbook for ICT, The University of Texas at Austin: Center for Occupational Curriculum Development, Division of Continuing Education, 1978.

RELATED TECHNICAL INFORMATION:

- Regulations of individual school or classroom.
- Regulations of The School District of Greenville County.
- Codes, laws, and ordinances.
- Materials and equipment handbooks and manuals.
- OSHA Regulations.
- E.P.A. Regulations.

Accompanied by addendum pages:

- Suggested Shop Safety Rules.
- Suggestions for maintaining a clean and orderly shop.
- Suggested Personal Safety Guide.
- Student Safety Pledge Form.

# Suggested Shop Safety Rules

A. Keep all hand tools clean, sharp if applicable, and in safe working order.

B. Report any defective tools, machines, or other equipment to the instructor.

C. Retain all guards and safety devices except with the specific authorization of the instructor.

D. Operate a hazardous machine only after receiving instruction on how to operate the machine safely.

E. Report all accidents to the instructor regardless of nature or severity.

F. Operator turns off power and makes certain the machine has stopped running before leaving.

G. Make sure all guards and barriers are in place and adjusted properly before starting a machine tool.

H. Disconnect the power from machine tools before performing the maintenance task of oiling or cleaning.

I. Use a solvent only after determining its properties, what kind of work it has to do, and how to use it.

J. Use correct, properly fitting wrenches for nuts, bolts, and objects to be turned or hold.

K. Keep the shop or laboratory floor clear of scraps and litter.

L. Have instructor check position of lift prior to raising vehicle on hydraulic lift.

M. Use safety jacks always when working under a vehicle (or to side of vehicle raised on jacks, etc.).

N. Do not smoke or light matches, etc., except in authorized area. Do not light matches, etc., near fumes of batteries or gasoline or flammable materials.

## Suggestions for Maintaining a Clean and Orderly Shop

A. Arrange machinery and equipment to permit safe, efficient work practices and ease in cleaning.

B. Stack materials and supplies safely or store them in proper place.

C. Store tools and accessories safely in cabinets, on racks, or in other suitable devices.

D. Clear working areas and work benches of debris and other hazards.

E. Clean and free floors from obstructions and slippery substances.

F. Free aisles, traffic areas, and exits or materials and other debris.

G. Dispose of combustible materials properly or store in approved containers.

H. Store oily rags in self-closing or spring-lid metal containers.

I. Know the proper procedures to follow in keeping the work area clean and orderly.

J. Keep sufficient brooms, brushes, and other housekeeping equipment readily available.

K. Clean up any spilled liquids immediately.

L. Oily rags or oily waste should be stored in metal containers.

M. Clean the chips from a machine with a brush--not with a rag or the bare hand.

N. Do not use compressed air to clean yourself or clothing.

# Suggested Personal Safety Rules

A. Wear shop clothing appropriate to the work activity being performed.

B. Always wear safety glasses or face protection as needed.

C. Confine long hair before operating rotating equipment.

D. Remove ties when working around machine tools, rotating equipment, or fan belts.

E. Remove rings and other jewelry when working in the shop, especially around electrical systems.

F. Always conduct yourself in a manner conductive to safe shop practices.

## STUDENT SAFETY PLEDGE FORM

________________________________, who is enrolled in Vocational Automotive Mechanics, will as a part of training, operate machines and equipment providing that the student's parent or guardian give written permission.

It is understood that each student will be given proper instruction, both in the use of the equipment and in correct safety procedures concerning it, before being allowed to operate it. The student must assume responsibility for following safe practices, and therefore, the student is asked to subscribe to the following safety pledge.

1. I promise to follow all safety rules for the shop.
2. I promise never to use a machine without first having permission from the instructor.
3. I will not ask permission to use a particular machine unless I have been instructed in its use, and have made 100 percent on the safety test for that machine.
4. I will report any accident or injury to the teacher immediately.

Date____________ Student's Signature______________________

I hereby give my consent to allow my son/daughter to operate all machines and equipment necessary in carrying out the requirements of the course in which enrolled.

Date __________ Parent's Signature ______________________

Parents are cordially invited to visit the shop to inspect the machines and to see them in operation.

UNIT 1.0-B AUTOMOTIVE MECHANICS - SAFETY

TASK B.02 USE PERSONAL PROTECTIVE EQUIPMENT

---

PERFORMANCE OBJECTIVE:

Given personal protective equipment guidelines, personal protection equipment, and a working situation, use personal protection equipment to meet the instructor's standards or other applicable standards such as OSHA.

PERFORMANCE ACTIONS:

B.0201 Wear approved safety clothing as required by standards.

B.0202 Wear approved eye and face protection when warranted.

B.0203 Use special equipment such as dust respirators or gloves as recommended by the instructor.

PERFORMANCE STANDARDS:

- Wear personal protective equipment to meet specified work situation requirements, to instructor's standards (or OSHA Standards).

SUGGESTED INSTRUCTION TIME: 1 Hour

RELATED TECHNICAL INFORMATION:

- Care of lenses and side shields of safety glasses.

# AUTOMOTIVE MECHANICS

# SAFETY PRACTICES AND RULES

## ADDENDUM

Think!

Be Careful!

It is the responsibility of each student to ensure that the automotive shop is a safe learning and work environment. Each student is responsible for correcting unsafe actions being committed by others. Any unsafe worker is liable to be more dangerous to others than to himself!

These suggestions for safety practices and rules in the automotive mechanics shop were developed using the following resources:

Resources listed in References

Mull, Dennis, "Safety Rules Auto Shop," Automotive Mechanics Instructor, Enoree Vocational Center, Greenville, SC.

Henderson, Wm. Edward Jr., "Safety Guide for Vocational Center Programs," 1970 (unpublished).

Safety Manual for North Dakota Vocational Education, Bismarck, ND: State Vocational Department, ca 1981.

## AUTOMOTIVE MECHANICS

## ENGINE SERVICING SAFETY

1. Check fuel lines for possible leaks.
2. Vent exhaust to outside of shop and provide adequate ventilation when running an engine whether in a stand or vehicle.
3. Never stand directly over a cylinder head while installing valve spring.
4. Keep head and hands away from revolving fan.
5. Do not position your body directly over a revolving fan.
6. Block wheels of any mobile engine test stand that you use.
7. Where necessary, have a carbon dioxide ($CO^2$) fire extinguisher available for flammable hazards.

## AUTOMOTIVE MECHANICS

## HOIST SAFETY

1. Place crane or hoist directly over object to be lifted.
2. Do not lift any object unless the chain, cable, or rope to be used is in good condition and properly attached.
3. Safety hook with latches must be used.
4. Double-check fastening of chain, cable, or rope to the object to ensure it is secure before lifting with crane or hoist. Balance object before lifting.
5. Make sure all persons and obstructions are clear before raising or lowering an engine or vehicle.
6. Support raised car with stands or blocks before doing work under the car or removing wheels.
7. Obtain permission from instructor before getting under a raised car.

## SAFETY WITH AUTOMOTIVE HAND TOOLS

1. Use tools only as they are designed to be used.
2. Make sure the tool is in good condition before using it. Do not use tools that are unsafe (i.e., damaged, etc.).
3. Report damaged or faulty tools to instructor and mark the tool unservicable (or turn it into tool room as unservicable).
4. Wear safety eye protection when using chisels.
5. Use chisel holders when using a chisel.
6. Place chisels at proper angles and push or strike with no more force than is necessary.
7. Do not use screwdrivers on objects held in hand.
8. When using a screwdriver, do not place your hand where it will be gouged if the tool slips.
9. Carry sharp tools (screwdrivers) with the points down and pointing away from you. Walk slowly and carefully and never run.
10. Never use the screwdriver as a pry or chisel.
11. Select a screwdriver of the proper size for the job.
12. Screwdrivers used near exposed electrical wires or terminals should be insulated.
13. Do not redress screwdriver tips on a grinder since this will destroy the temper. Use a hand file which allows better control of the shape of the head.
14. Pliers are not wrenches. They should only be used for holding, turning, squeezing, and cutting.
15. Wear proper eye protection and hold wire low as possible when cutting with the pliers.
16. Do not hit (strike) two hard objects such as hammers together.

## USING WRENCHES SAFELY

1. Always pull on a wrench. You have more control over the tool and there is less chance of injury.

2. Select a wrench that fits properly. A loose-fitting wrench may slip and round off the corners of the bolt head or nut.

3. Never hammer on a wrench to loosen a stubborn fastener, unless the tool has been designed for this job.

4. It is dangerous practice to lengthen the wrench handle for additional leverage. Use a larger wrench.

5. When using wrenches, clean grease and oil from the floor in the work area to reduce the possibility of slipping and loosing your balance.

6. Do not use a wrench on moving machinery.

## SAFETY IN BATTERY SERVICING

1. Obtain permission from instructor before servicing or charging storage battery.
2. Use proper instrument for testing a storage battery.
3. Avoid overfilling a battery, especially if it is to be charged.
4. Use water and a neutralizer such as baking soda to clean off the top of a battery.
5. Remove and transport a battery with a battery lifter.
6. Handle battery or battery acid with care. Wash immediately any part of your skin or clothing that comes in contact with acid.
7. Rinse eyes with water immediately if battery acid comes into contact with the eye.
8. Wash hands immediately after handling a battery.
9. Do not check electrolyte in battery with match.
10. Do not light a match, etc., around battery fumes.
11. When charging a battery:
    a. Wear eye protection devices.
    b. Provide ample ventilation when charging.
    c. Keep open flames and sparks away from a battery being charged.
    d. Turn off charger before disconnection leads from charger to battery or follow manufacturer's procedures.

## STEAM CLEANER HIGH PRESSURE WASHER SAFETY

1. Eye protection should be worn.
2. Obtain instructor's permission to use steam cleaner/high pressure washer machine.
3. Wear protective clothing.
4. Keep all safety devices in good working order and in place.
5. Make all adjustments with power off and burner cool.
6. Select area of work for protection of others, etc.
7. Check to be sure there is sufficient water flowing through steam cleaner before lighting burner.
8. Check location of controls and procedure for emergency shut down.
9. Check electrical connections to ensure they are tight and to be certain they will not become wet or lie in water or on damp ground and be a potential electrical hazard.
10. Always hold steam cleaner hose by insulated hand grip, and wear gloves to prevent burns to hands.
11. Never point the steam cleaner nozzle toward other persons.
12. Check work area to be sure there are no persons in a location where they will be accidentally sprayed.
13. Keep a constant check to be sure there is sufficient water in-flow to ensure safe and proper operation.
14. Never operate steam cleaner unless water droplets are omitted with steam.
15. When shutting off steam cleaner, turn off burner first and leave water pump running until clear cool water flows from the steam hose, then turn off water. Never leave the steam cleaner until it has been completely shut down.

# AUTOMOTIVE MECHANICS

## SAFETY RULES FOR SERVICING

1. Keep legs under a car when working on a creeper.
2. Keep creeper standing when it is not in use.
3. Make sure all doors of vehicle are closed before getting under a car.
4. Watch out for a student working on an engine loosing debris or dropping tools that might fall on a student under the vehicle.
5. Stand to one side when starting engines.
6. Remove a warm radiator cap slowly and let pressure "bleed" off.
7. Do not touch hot exhaust manifolds.
8. Be careful of compressed air lines.
9. Remove rings and watches and braclets while working around electrical systems.
10. Disconnect battery when doing electrical repair.
11. Disconnect the ground strip on the battery first.
12. Protect yourself against battery acid by covering your skin and clothes with protective materials.
13. Make sure a raised car is resting firmly on jacks or hoist brackets.
14. Make sure extendable lift arms are in place before raising vehicle.
15. Using lift barely raise car, check lift position, then lift vehicle.
16. Do not touch lift controls while vehicles are raised on lift.
17. When lift is in raised position, use safety guard if provided.
18. Use safety car stands to back up lifting devices.
19. Watch for gasoline leaks.
20. Keep jack handles in the upward position.
21. Use engine hoist for heavy lifting.
22. Use transmission stand when appropriate.

23. Never reach hand into carburetor cleaner.

24. Never operate vehicle (motor) in closed shop area without exhaust fan on.

25. Never stand or stoop over cooling fan of operating engine. (Watch for flying debris from operating fan when working on engine.)

26. Drive cars in and out of shop with caution.

27. When backing a vehicle in or near the shop entrance, ask another student to guide you (watch for objects, persons, etc.).

UNIT 1.0-B AUTOMOTIVE MECHANICS - SAFETY

TASK B.03 PRACTICE SAFETY IN USING POWER TOOLS (and Machinery)

---

PERFORMANCE OBJECTIVE:

Given proper instructions, power tools used in automotive servicing, use power tools safely according to manufacturer's specifications/instructions and meet instructor's standards (or local codes, OSHA Standards).

PERFORMANCE ACTIONS:

B.0301 Able to identify principles of operations, methods of use, and general and special safety precautions of any power tools prior to operating it.

B.0302 Check to be sure all power tools are grounded (unless approved double insulated). Power tools should have a 3-wire conductor cord. If an adaptor plug is used to allow a 3-ground plug to be plugged in a 2-hole outline, use separate ground wire. Use correct voltage.

B.0303
- (a) Unplug power tool when changing belts, bits, etc.
- (b) Don't leave a power tool until it has stopped running (while a machine is coasting).

B.0304 Always use safety guards provided with power tools.

B.0305 When work is completed, unplug power plug. Always turn switch of power tool to "off" prior to connecting power plug. Always turn switch to "off" when work is completed.

B.0306 If extension cord is needed, use recommended cord size. Cord should not run through water or be placed so damage may occur.

B.0307 Inspect power tools for worn power cords, proper adjustments.

B.0308 Store power tools properly or label and remove from use power tools which are defective.

PERFORMANCE STANDARDS:

- Able to properly and safely use automotive mechanic's power tools to manufacturer's instructions/specifications or

UNIT 1.0-B AUTOMOTIVE MECHANICS - SAFETY

TASK B.03 PRACTICES SAFETY IN USING POWER TOOLS (and Machinery) (Con't.)

---

PERFORMANCE STANDARDS (Con't.):

instructor's standards (applicable code or OSHA standards), without damage to tools, and with "ZERO" accidents.

SUGGESTED INSTRUCTION TIME: 1 Hour

RELATED TECHNICAL INFORMATION:

- Manufacturer's instructions/specification on each power tool.
- Electrical codes and safe practices of electrical use.
- Safety guard used with power tools.

NOTE: Obtain competency qualification (instructor's) approval prior to operation of power hand tools or machinery.

UNIT 1.0-B AUTOMOTIVE MECHANICS - SAFETY

TASK B.04 IDENTIFY TYPICAL SHOP SAFETY HAZARDS

---

## PERFORMANCE OBJECTIVE:

Given proper instruction, orientation to OSHA safety requirements, and introduction to a typical shop hazard; identify safety practices or safety hazards that violate OSHA Standards or instructor's standards.

## PERFORMANCE ACTIONS:

B.0401 Identify or list shop safety hazards.

B.0402 Cite proper safety practices for each hazard cited.

## PERFORMANCE STANDARDS:

- Identify potential safety hazards of automotive service shop with 5 percent accuracy.
- Demonstrate safety practices to meet OSHA requirements, accepted standards of the industry, and instructor's standards.

SUGGESTED INSTRUCTION TIME: 3 Hours

## RELATED TECHNICAL INFORMATION:

- School and shop regulations.
- Personal safety practices.
- Local, State, and Federal safety regulations.

| | | |
|---|---|---|
| UNIT | 1.0-B | AUTOMOTIVE MECHANICS - SAFETY |
| TASK | B.05 | DEMONSTRATE OR INTERPRET EMERGENCY PROCEDURES TO RESPOND TO SHOP INJURIES |

---

PERFORMANCE OBJECTIVE:

Given proper instruction concerning shop hazards, emergency first aid procedures for handling injuries, and simulated situations; demonstrate or interpret how to perform first aid for possible shop injuries according to acceptable first aid techniques.

PERFORMANCE ACTIONS:

B.0501 Cite first aid requirements for given potential shop injuries.

B.0502 Demonstrate or interpret how to perform emergency first aid for shop injuries.

PERFORMANCE STANDARDS:

- Peforms or interprets how to perform first aid for shop injuries, following correct emergency procedures with 95 percent accuracy.

SUGGESTED INSTRUCTION TIME: 2 Hours

RELATED TECHNICAL INFORMATION:

- Burns.
- Fire prevention.
- Fire safety procedures.
- Handling acid (battery acid).
- Lifting.
- Ventilation in automotive shops.
- Electrical shock.
- Cuts.

UNIT 1.0-B AUTOMOTIVE MECHANICS - SAFETY

TASK B.06 DEMONSTRATE FIRE SAFETY PRECAUTIONS AND PRACTICES

---

PERFORMANCE OBJECTIVE:

Given instruction, orientation to different types of fires and fire extinguishing equipment, and simulated situation, explain typical steps to take when experiencing a fire; how to extinguish small fires to include Class A, B, and C fires; and operation of typical fire extinguishing equipment.

PERFORMANCE ACTIONS:

B.0601 Identify fire hazards in automotive mechanics work.

B.0602 Describe the different classes of fires:
- Class A
- Class B
- Class C

B.0603 Check:
- Fire exits
- Placement of fire extinguishers
- Working order of fire extinguishing equipment

B.0604 Explain/demonstrate (simulated) operation of fire extinguishing equipment.

PERFORMANCE STANDARDS:

- Identify fire hazards in automotive mechanics work and how to deal with Class A, B, and C types of fires.
- Demonstrate (by simulation or explanation) the operation of given fire extinguishing equipment.
- The instructor's standards applies.
- As applicable, fire codes, etc., apply.

SUGGESTED INSTRUCTION TIME: 3 Hours

RELATED TECHNICAL INFORMATION:

- Discriminate when to classify a fire as controllable locally (by staff) and when to evacuate personnel and call the fire department.
- Importance of fire exit codes.
- Dangers of smoke.

# FIRE EXTINGUISHER INSPECTION CHECKLIST

DIRECTIONS: Check the appropriate column to indicate whether the fire extinguisher placement and condition meet the criteria.

| The fire extinguisher's | No | Yes |
|---|---|---|
| 1. location is proper and there are no obvious mechanical damage or corrosion. | | |
| 2. safety seals have not been tampered with or used. | | |
| 3. nameplate, gauge, or indicator is visible and readable. | | |
| 4. weight indicates that it is fully charged (lift to determine). | | |
| 5. nozzle opening is free of obstruction. | | |
| 6. gauge or indicator is in operable range. | | |

Student: ____________________

# UNIT 1.0-C

# CAREER OPPORTUNITIES
# IN
# AUTOMOTIVE MECHANICS

| | | |
|---|---|---|
| UNIT | 1.0-C | AUTOMOTIVE MECHANICS<br>INTRODUCTION - CAREER OPPORTUNITIES |
| TASK | C.01 | IDENTIFY TYPICAL AUTOMOTIVE MECHANICS AND RELATED CAREER OPPORTUNITIES |

---

## PERFORMANCE OBJECTIVE:

Given instruction, data on the local automotive service industry, primarily auto mechanics and opportunities to study the auto service and related industry; identify the major catagories of potential employers in the local community (and the key characteristics of each).

## PERFORMANCE ACTIONS:

"Performance actions may vary from center to center due to the potential employers served and the emphasis of the individual automotive mechanics program."

C.0101 Identify types of job opportunities for the automotive mechanics graduate.

C.0102 Describe automotive mechanics job availabilities in the Piedmont region of South Carolina and in Greenville County in particular.

## PERFORMANCE STANDARDS:

- Identify typical types of automotive mechanics businesses in the local community and the major characteristics that distinguish them based on given instruction, local market data, and student observation.
- Meet instructor's standards.

## SUGGESTED INSTRUCTION TIME: 3 Hours

## RELATED CAREER OPPORTUNITIES:

- Auto Dealership career opportunities.
- Independent Auto Service Business Opportunities.
- Related Services such as Parts Counter Worker, retail auto parts sales, adjuster, etc.

## RELATED TECHNICAL INFORMATION:

- Employment Security Commission (S.C.) data concerning the automotive service and related industries in Greenville County (Statistician, Employment Security Commission, Greenville, SC).

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RELATED TECHNICAL INFORMATION (Con't.):

- Service and craft association in the local area.
- Newspaper "Want Ads."

UNIT 1.0-C AUTOMOTIVE MECHANICS
INTRODUCTION - CAREER OPPORTUNITIES

TASK C.02 OBTAINING A JOB

---

PERFORMANCE OBJECTIVE:

Given proper orientation concerning the automotive service industry, describe how to get a job and hold it to the instructor's standards (or standards of the guidance or placement office).

PERFORMANCE ACTIONS:

C.0201 Tell how to get a job in the automotive servicing or a related industry.

C.0202 Describe how to hold a job: Reliability, characteristics of a good worker (suggestions of area service industry), following instructions, etc.

C.0203 Complete a typical job application form. (Suggested that this task be coordinated with the Vocational Center Guidance or Job Placement offices.

PERFORMANCE STANDARDS:

- List important aspects of getting and holding a job in the automotive service industry with 90 percent accuracy on written knowledge test.
- Complete typical job application form to the standards of the instructor (guidance or placement office).

SUGGESTED INSTRUCTION TIME: 1 Hour

RELATED TECHNICAL INFORMATION:

- Shop manuals and other related automotive reference.
- National Institute for Automotive Service Excellence material.
- Job application forms.

SUGGESTION:

- Invite a local automotive shop service manager or foreman to speak to students concerning "what the service shop looks for in potential employees."

UNIT 1.0-C AUTOMOTIVE MECHANICS
INTRODUCTION - CAREER OPPORTUNITIES

TASK C.03 IDENTIFY TECHNICIAN'S RESPONSIBILITIES TOWARD THE EMPLOYERS, CUSTOMER, AND CRAFT

---

PERFORMANCE OBJECTIVE:

Given instruction concerning the automotive mechanics responsibilities toward the employer, customer, and craft; interpret and demonstrate in practical training the attitudes and performance standards that the local automotive service industry (or instructor) expects from the graduate toward the employer, customer, and craft.

PERFORMANCE ACTIONS:

C.0301 Describe how to demonstrate responsibility toward the employer.

C.0302 Describe how to demonstrate responsibility toward the customer.

C.0303 Describe how to demonstrate responsibility toward the automotive service craft.

PERFORMANCE STANDARDS:

- Describe how to demonstrate responsibility toward the employer, customer, and the automotive service craft with 80 percent accuracy on written knowledge tests and shows evidence of practicing in the training situation or on-the-job the standards of the local automotive service industry for key elements in responsibility toward the employer, customer, and craft to the instructor's standards.

SUGGESTED INSTRUCTION TIME: 1 Hour

RELATED TECHNICAL INFORMATION:

- Standards of local auto service industry (indicated by advisory committee input, survey, etc.).
- Mechanic testing and Certification Programs.

SEE: Tasks for Job Performance and Work Attitude.

UNIT 1.0-C AUTOMOTIVE MECHANICS
INTRODUCTION - CAREER OPPORTUNITIES

TASK C.04 IDENTIFY HOW TO MEET PEOPLE AND TO BE ACCEPTED BY FELLOW WORKERS IN THE SERVICE FIELD

---

PERFORMANCE OBJECTIVE:

Given a proper orientation concerning how to meet people and to be accepted by fellow workers in the automotive service field, identify the proper activities and attitudes to make a good impression with people and to be accepted by fellow workers, 80 percent accuracy on written knowledge tests and must meet instructor's standards in demonstrated performance.

PERFORMANCE ACTIONS:

C.0401 Describe how to meet people and make a good impression.

C.0402 Explain how to be accepted by fellow employees. (i.e., honest, sharing in work, helping others, returning items borrowed, working at getting along with others, shop etiquette, etc.).

PERFORMANCE STANDARDS:

- Describe how to meet people and to be accepted by fellow workers on written knowledge test with 80 percent accuracy and apply the characteristics, etc., in daily performance in the class/lab meeting the instructor's standards.

SUGGESTED INSTRUCTION TIME: 1 Hour

RELATED TECHNICAL INFORMATION:

- Recommendations of local automotive service industry.

# UNIT 1.0-D

# JOB PERFORMANCE AND WORK ATTITUDES
# IN
# AUTOMOTIVE MECHANICS

UNIT 1.0-D AUTOMOTIVE MECHANICS - JOB PERFORMANCE AND WORK ATTITUDES

TASK D.01 (Optional) JOB PERFORMANCE

---

PERFORMANCE OBJECTIVE:

Given instruction, demonstrate job performance characteristics that are considered important to entry-level career success in the vocational field. A "Job Performance Rating Sheet" will be used to evaluate performance and all items must be rated "frequently" or above.* *(See note below.)

PERFORMANCE ACTIONS:

D.0101 Review important work characteristics for the vocational field.

D.0102 Review the "Job Performance Rating Sheet" with the instructor.

D.0103 Demonstrate those work characteristics that are considered important to success in the vocational field.

PERFORMANCE STANDARDS:

- Demonstrate by personal performance the work characteristics that are considered important to success in construction work.
- A "Rating Sheet" will be used to evaluate performance and all items must be rated "frequently" (observed) or above.

SUGGESTED INSTRUCTION TIME: 2 Hours

Accompanied by addendum page (Rating Sheet)

Rating sheet includes the following categories:

- Accuracy of work
- Care of working space
- Care of equipment
- Speed
- Use of working time
- Initiative
- Attendance
- Attitude toward fellow workers
- Attitude toward teacher
- Observance of safety rules
- Use of materials
- Responsibility
- Accident report
- Personal appearance, cleanliness

*NOTE: It is the general recommendation of instructor task force committees that employer-recommended "job performance characteristics" and "work attitudes" be included as part of the vocational student's overall training and that demonstrated performance in these areas be included in the total evaluation of the student.

Addendum to Task D.01

## JOB PERFORMANCE RATING SHEET

Student ______________________ Job Performed ______________

Dates from ____________________ to ______________________

Place of work __________________ Supervisor ________________

DIRECTIONS: Circle the number that best fits your opinion of the student's performance using the following factors:

| | Never | Seldom | Frequently | Usually | Always |
|---|---|---|---|---|---|
| 1. Gets to work on time | 0 | 1 | 2 | 3 | 4 |
| 2. Uses time properly | 0 | 1 | 2 | 3 | 4 |
| 3. Shows interest in work | 0 | 1 | 2 | 3 | 4 |
| 4. Shows dependability | 0 | 1 | 2 | 3 | 4 |
| 5. Is ambitious | 0 | 1 | 2 | 3 | 4 |
| 6. Is neat (work and self) | 0 | 1 | 2 | 3 | 4 |
| 7. Works well with others | 0 | 1 | 2 | 3 | 4 |
| 8. Follows directions | 0 | 1 | 2 | 3 | 4 |
| 9. Works without supervision | 0 | 1 | 2 | 3 | 4 |
| 10. Shows good manners | 0 | 1 | 2 | 3 | 4 |
| 11. Meets people well | 0 | 1 | 2 | 3 | 4 |
| 12. Uses knowledge on the job | 0 | 1 | 2 | 3 | 4 |
| 13. Seeks assistance, when necessary | 0 | 1 | 2 | 3 | 4 |

Does the worker have the skills for doing satisfactory work? Yes __ No __

List the skills or characteristics that need to be developed or improved upon:

______________________________________________

______________________________________________

______________________________________________

______________________________________________

Additional comments:

______________________________________________

______________________________________________

______________________________________________

Date ______________________ Supervisor ________________

UNIT 1.0-D AUTOMOTIVE MECHANICS - JOB PERFORMANCE AND WORK ATTITUDES

TASK D.02 WORK ATTITUDES

---

PERFORMANCE OBJECTIVE:

Given instruction, demonstrate work attitudes that the majority of potential employers prefer in an entry-level worker. Performance will be evaluated on a "Work Attitudes Score Card" and a minimum of 90 percent should be attained. Performance will be rated through training and should improve to 100 percent by the end of the training period.*

PERFORMANCE ACTIONS:

D.0201 Review work attitudes considered important to success in the vocational field.

D.0202 Review the "Work Attitudes Score Card."

D.0203 Demonstrate the type of work attitudes that potential employers in the local industry report as important to job success.

PERFORMANCE STANDARDS:

- Demonstrate to 80 percent acceptable rating on a "Work Attitude Score Card" to be completed by the instructor those work attitudes considered important by local potential employers for entry-level job success.

SUGGESTED INSTRUCTION TIME: 2 Hours

Accompanied by addendum page (Work Attitudes Score Card)

*NOTE: It is the general recommendation of the instructor task force committees that employer-recommended "job performance characteristics" and "work attitudes" be included as part of the vocational student's overall training and that demonstrated performance in these areas be included in the total evaluation of the student.

Addendum to Task D.02

## WORK ATTITUDE SCORE CARD

DIRECTIONS: Score the learner on the following attitudes and work behavior by circling the appropriate description either "yes" (+) or "no" (-). Indicate any comments to support the rating or recommendations.

| | Circle | | Comments/ Recommendations |
|---|---|---|---|
| | (No) | (Yes) | |
| Cooperative | - | + | |
| Courteous | - | + | |
| Loyal | - | + | |
| Tackful | - | + | |
| Self Disciplined | - | + | |
| Respectful | - | + | |
| Alert | - | + | |
| Motivated | - | + | |
| Responsible | - | + | |
| Trustworthy | - | + | |
| Dependable | - | + | |
| Cheerful | - | + | |
| Polite | - | + | |
| Interest | - | + | |
| Friendly | - | + | |
| Sympathetic | - | + | |
| Accepts changes | - | + | |
| Follows rules and regulations | - | + | |
| Does share of work | - | + | |
| Helps others, if needed | - | + | |
| Works regularly | - | + | |
| On time | - | + | |
| Shows pride in work | - | + | |
| Keeps promises | - | + | |
| Does not waste time | - | + | |
| Controls anger | - | + | |
| Accepts criticism | - | + | |
| Follows superior's directions | - | + | |

28 Items total TOTAL (+'s) ____________

Interpretation

28 = 100% = Level 4 Competency Rating (See competency reporting scale)
25 = 90% = Level 3 Competency Rating
22 = 80% = Level 2 Competency Rating
20 = 70% = Level 1 Competency Rating
17 = 60% = Level 0 Competency Rating

Student: ______________________________

# UNIT 1.0-E

# AUTOMOTIVE MECHANICS

# SHOP MATH

TASK E.01 BASIC MATH REVIEW - SIMPLE FRACTIONS

---

PERFORMANCE OBJECTIVE:

Given a pretest or examples by the instructor, conduct the following operations with fractions:

1. Change any fraction to a decimal number, and any terminating decimal number to a fraction.
2. Arrange in order...unit and simple nonunit fractions.
3. Write equivalent fractions in higher, lower, and lowest terms.
4. Write improper fractions as whole or mixed numbers, and mixed numbers as improper fractions.
5. Multiply fractions and mixed numbers, expressing answers in simplest form.
6. Divide fractions and mixed numbers, expressing answers in simplest form.
7. Add and subtract unlike fractions expressing answers in simplest form.
8. Add and subtract mixed numbers with unlike fractions, expressing answers in simplest form.
9. Use rational numbers to solve simple word problems.

PERFORMANCE ACTIONS:

Consult: Curriculum Guide for High School General Mathematics, Greenville, SC: The School District of Greenville County, 1979.

SUGGESTED INSTRUCTION TIME: 1 Hour (Actual hours of instruction will be determined by student's math skill as indicated by pretest. Remedial instruction may be at initiation of Automotive Mechanics I or as the actual skill is required.)

PERFORMANCE STANDARDS:

- Add, subtract, multiply, and divide simple fractions.
- Student should be able to complete pretest in Math Curriculum Guide with 90 percent accuracy.
- Consult the Math Curriculum Guide for pretests, suggested exercises, and references.

(NOTE: The level of this math skill is eighth grade, General Math I.)

UNIT 1.0-E AUTOMOTIVE MECHANICS - SHOP MATH

TASK E.02 BASIC MATH REVIEW - DECIMALS AND PERCENTAGES

---

PERFORMANCE OBJECTIVE:

Given a pretest or examples by the instructor, conduct the following decimal math operations:

1. Name the place value of digits in decimal numbers of up to three digits before the decimal and three digits after the decimal.
2. Compare decimal numbers and arrange them in order.
3. Write the numberal for any decimal number of up to three decimal places.
4. Round decimal numbers to any designated place value up to thousandths.
5. Add and subtract decimal numbers of up to three digits.
6. Multiply decimal numbers by whole numbers or decimal numbers.
7. Divide a number by a three digit decimal number.
8. Multiply and divide decimal numbers by powers of ten, by inspection.

PERFORMANCE ACTIONS:

Consult: Curriculum Guide for High School General Mathematics, Greenville, SC: The School District of Greenville County, 1979.

SUGGESTED INSTRUCTION TIME: 1 Hour (Actual hours of instruction will be determined by the student's math skill as indicated by pretest. Remedial instruction may be at initiation of Automotive Mechanics I or as the actual skill is required.)

PERFORMANCE STANDARDS:

- Explain or demonstrate how to interchange fractions, decimals, and percentages.
- Student should be able to complete pretest in Math Curriculum Guide with 90 percent accuracy.
- Consult: Curriculum Guide for High School General Mathematics, Greenville, SC: 1979, for pretests, suggested exercises, and references.

(NOTE 1: The level of this math skill is eighth grade, General Math I.)

(NOTE 2: The mechanic should be able to give reasons for allowing discounts and explain how different discounts are given and how due dates are adjusted.

Possible Terminology: Trade discount, vendor's discount, cash discount, quantity discount, Net 30, EOM (end of month), ROG (receipt of goods), and Extra Dating (extension of discount data), and Anticipation (payment before due date.)

UNIT 1.0-E AUTOMOTIVE MECHANICS - SHOP MATH

TASK E.03 READING MICROMETERS

---

PERFORMANCE OBJECTIVE:

Given instruction, a micrometer (typical to automotive mechanics work), and a practical exercise; identify the parts of the micrometer, explain how to hold the micrometer when using it, demonstrate how to read the micrometer, and given accurate readings from a micrometer drawing showing gauge settings.

PERFORMANCE ACTIONS:

E.0301 Identify the parts of a given micrometer:
  a. Anvil
  b. Spindle
  c. Frame
  d. Cutout frame
  e. Clamp Ring (Lock Nut)
  f. Barrel (Sleeve)
  g. Thimble
  h. Ratchet Stop

E.0302 Demonstrate how to read the micrometer.

E.0303 Read the micrometer to 1/1,000 inch.

E.0304 Read the micrometer to 1/10,000 inch. (Optional)

PERFORMANCE STANDARDS:

- On given micrometer drawings, make accurate readings of the micrometer scale to 1/1,000 inch as required by the instructor with 90 percent accuracy.

SUGGESTED INSTRUCTION TIME: 2 Hours

RELATED TECHNICAL INFORMATION:

- Decimals
- Fractions

TASK E.04 METRIC MEASUREMENTS AND EQUIVALENTS

---

PERFORMANCE OBJECTIVE:

Given instruction in the metric system of measurements and conversion from United States Customary units to metric; read and convert dimensions from one system into the other on instructor provided problems. Accuracy should be 100 percent.

PERFORMANCE ACTIONS:

E.0401 Demonstrate ability to read and use U.S. Customary measurements, especially length measurements, with 100 percent accuracy on given problems.

E.0402 Identify basic SI (Metric System) units and their symbols:
- a. Millimeter (linear measurement)
- b. Centimeter (")
- c. Meter (")
- d. Ampere (electric current)
- e. Kelvin (temperature)
- f. Candela (Luminous)
- g. Kilometer Per Hr. (KM)

E.0403 Identify basic Metric prefixes:

| Prefix | Amount | Fraction | Decimal |
|---|---|---|---|
| Milli | One-thousandth | 1/1,000 | 0.001 |
| Centi | One-hundredth | 1/100 | 0.01 |
| Deci | One-tenth | 1/10 | 0.1 |
| Deka | Ten | 10 | 10.0 |
| Hecto | Hundred | 100 | 100.0 |
| Kilo | Thousand | 1,000 | 1,000.0 |

E.0404 Accurately measure given objects or distances in the required metric system.

E.0405 Convert Inches to Millimeters
(Inches X 25.4 = Millimeters)

E.0406 Convert Millimeters to Inches
(Millimeters X 0.0394 = Inches)

PERFORMANCE STANDARDS:

- With an accuracy of 100 percent, convert given dimensions from one system to the other system (U.S. Customary to Metric to U.S. Customary), with emphasis on linear measurements in metric (cm, mm).

SUGGESTED INSTRUCTION TIME: 1 Hour

# UNIT 1.0-F

# AUTOMOTIVE MECHANICS

# TOOLS AND EQUIPMENT

UNIT 1.0-F AUTOMOTIVE MECHANICS
TOOLS AND EQUIPMENT

TASK F.01 IDENTIFICATION AND USE OF COMMON HAND TOOLS AND MEASURING DEVICES

---

PERFORMANCE OBJECTIVE:

Given proper instruction concerning the identification, use, and care of automotive shop tools and measuring devices, selected tools and measuring devices; identify, state the use of, and demonstrate how to use the tools and measuring devices meeting instructor's standards.

PERFORMANCE ACTIONS:

F.0101 Identify shop hand tools and measuring devices used in the typical automotive service shop.

F.0102 Describe purpose of each tool or measuring device.

F.0103 Demonstrate how to use and maintain shop hand tools and measuring devices.

PERFORMANCE STANDARDS:

- Identify given automotive shop hand tools and measuring devices with 80 percent accuracy.
- Demonstrate the proper use and care of hand tools and measuring devices with 90 percent accuracy, meeting instructor's standards.

SUGGESTED INSTRUCTION TIME: 9 Hours

RELATED TECHNICAL INFORMATION:

- Use of tool and storage room.
- Care of tools and proper storage of tools.
- Cleaning materials (used for tools, etc.).

(NOTE: Power tools and equipment included but not limited to common electrical power tools, compressed power tools, hydraulic power, and metal working tools are included in task F.02.)

| | | |
|---|---|---|
| UNIT | 1.0-F | AUTOMOTIVE MECHANICS<br>TOOLS AND EQUIPMENT |
| TASK | F.02 | IDENTIFY AND PROPERLY USE COMMON<br>AUTOMOTIVE SHOP MACHINERY |

---

PERFORMANCE OBJECTIVE:

Given proper instruction, typical automotive shop machinery, and situations in which such machinery might be employed; state the purpose of given items of shop machinery with 80 percent accuracy and demonstrate the proper use of the machinery with 90 percent accuracy.

(NOTE: Orientation to shop machinery. Proficiency will result from use of machinery during later training.)

PERFORMANCE ACTIONS:

F.0201 Identify and state purpose of given items of commonly used automotive shop machinery with 80 percent accuracy.

F.0202 Demonstrate how to properly use given items of shop machinery with 90 percent accuracy.

PERFORMANCE STANDARDS:

- For given automotive shop machinery, identify by proper terminology and use automotive machinery with 80 percent accuracy.
- Demonstrate with 90 percent accuracy the use of shop machinery meeting instructor's standards.

(NOTE: Demonstration of use of equipment for proficiency typically will occur later in training when equipment is being used for service, diagnosis, or repair, etc.).

SUGGESTED INSTRUCTION TIME: 2 Hours

RELATED TECHNICAL INFORMATION:

- Manufacturer's instructions. Manufacturer's specifications.
- Safety precautions.
- Diagnostic information (if applicable) to indicate use of machinery.
- Specifications (vehicle).

UNIT 1.0-F AUTOMOTIVE MECHANICS TOOLS AND EQUIPMENT

TASK F.02 IDENTIFY AND PROPERLY USE COMMON AUTOMOTIVE SHOP MACHINERY (Con't.)

---

MACHINERY INCLUDES (BUT NOT LIMITED TO):

- Grinders
- Drills
- Jacks
- Lifts
- Air Compressor
- Aligner, Front End

Balancer, Wheel
Battery Starter Tester
Armature Lathe Turner
Charger, Battery
Grinder
Valve Shop

Addendum to Task 1.0-F

## AUTOMOTIVE MECHANICS

### MASTER TOOL & EQUIPMENT LIST
(For Class Size - 15 Students)

| DESCRIPTION | NUMBER EACH |
|---|---|
| **Wrenches:** | |
| Combination 5/16, 3/8, 7/16, 1/2, 9/16 (sets) (box & open end) | 5 sets |
| Combination 11/16 through 1 1/4 (box & open end) | 5 sets |
| Ignition sets | 3 sets |
| Adjustable 4-6-8-10 inch (Crescent) 12 inch | 1 each |
| Pipe 8-12-16 inch | 1 each |
| Valve adjusting | 1 set |
| Flare nut | 1 set |
| Distributor | 1 each |
| Drain plug | 1 each |
| Torque 3/8" drive 0-150 in. lbs.<br>1/2" drive 10-150 ft. lbs. | 2 each |
| Brake adjusting tool (assorted types) | 3 each |
| Brake bleeding wrench (assorted types) | 3 each |
| Hand impact driver | 1 each |
| **Socket Sets:** | |
| 1/4 inch drive | 3 sets |
| 3/8 inch drive Flexsocket & deep hex sockets | 3 sets |
| 1/2 inch drive Flexsocket & deep hex sockets | 3 sets |
| Spark plug socket 5/8" & 13/16" Flexsocket | 3 each |
| Oil pressure and temperature sending unit socket | 1 each |

**Gages:**

| | |
|---|---|
| Spark Plug (wire) | 3 each |
| Feeler gage (flat) 1 to 40 thousandths | 3 each |

**Pliers:**

| | |
|---|---|
| Needle-nose 6" | 3 each |
| Diagonal Cutting 6" | 3 each |
| Vise grips 10" | 3 each |
| Channel Lock 12" | 3 each |
| General purpose 8" | 3 each |
| Hose clamp 7 3/4" | 3 each |
| Battery pliers | 1 each |
| Snap ring (internal) set | 1 each |
| Snap ring (external) set | 1 each |
| Wire crimper | 1 each |
| Spark plug terminal plier | 1 each |

**Screwdrivers:**

| | |
|---|---|
| Regular - set of 6 | 3 sets |
| Phillips Head - set of 6 | 3 sets |
| Clutch Head (figure 8) set of 4 | 1 set |
| Offset Regular & Phillips | 1 set each |

**Hammers:**

| | |
|---|---|
| Ball pein (small) 4 oz. | 3 each |
| Ball pein (medium) 8 oz, | 3 each |
| Ball pein (large) 16 oz. | 3 each |

| | |
|---|---|
| Sledge 2 1/2 lb. | 3 each |
| Soft face (plastic) 1/2 and 1 lb. | 3 each |
| Chain hoist and trolley | 1 each |
| Air compressor | 1 each |
| Oxyacetylene welding and cutting outfit | 1 each |
| Electric arc welder | 1 each |
| Valve shop | 1 each |
| Engine stands | 5 each |
| Armature growler | 1 each |
| Bench grinder and buffer combination | 1 each |
| Electric drill 1/4 and 1/2 inch cap. | 1 each |
| Drill press (bench or floor model) | 1 each |
| Drill bits - high speed | 2 sets |
| Work benches (metal) | 5 each |
| Drain pans (oil) | 3 each |
| Drain pans (water) | 3 each |
| Gasoline can | 1 each |
| Radiator filler | 1 each |
| Battery hydrometer | 1 each |
| Anti-freeze hydrometer | 1 each |
| Floor creepers | 5 each |
| Ign. timing light | 3 each |
| Extension cords (lights) | 5 each |
| Oilers (plews pistol grip) | 3 each |
| Oil pouring spout | 3 each |
| Brake fluid dispenser | 1 each |

Addendum to Task 1.0-F

| | |
|---|---|
| Transmission grease dispenser | 1 each |
| Transmission fluid funnel (flexible) | 2 each |
| Rubber mallet | 3 each |
| Chisels: | |
| Regular-assorted sizes | 3 sets |
| Punches: | |
| Center-assorted sizes | 3 sets |
| Pin-assorted sizes | 3 sets |
| Hand hack saws | 3 each |
| Files-assorted sizes and shapes | 3 sets |
| C-Clamps 3 to 6 inch | 2 each |
| Steel rule (tape) 6 foot | 3 each |
| Steel rule (flat) 12 inch | 3 each |
| Straigh edge | 1 each |
| Calipers (inside) 3", 4", 6", 8" | 1 each |
| Calipers (outside) 3", 4", 6", 8" | 1 each |
| Micrometers: | |
| 0-1 inch | 1 each |
| 1-2 inch | 1 each |
| 2-3 inch | 1 each |
| 3-4 inch | 1 each |
| 4-5 inch | 1 each |
| 5-6 inch | 1 each |
| Inside dial indicator | 1 each |

| | |
|---|---|
| Floor jack 4 ton | 2 each |
| Hydraulic jack (upright) large (10 ton) - small (5 ton) | 1 each |
| Car stands | 12 each |
| Soldering gun (pistol grip) 100w & 500w | 2 each |
| Electric soldering iron (large) | 1 each |
| Ring ridge reamer | 2 each |
| Ring groove cleaner (piston) | 3 each |
| Ring compressor (piston) | 3 each |
| Compression tester | 1 each |
| Vacuum and fuel pump testers | 1 each |
| Brake cy. hone | 2 each |
| Engine cyl. hone | 1 each |
| Vises, 4 inch | 2 each |
| Vises, 6 inch | 1 each |
| Gear and wheel pullers-Master Puller Set | 1 set |
| Tune-up or engine analyzer | 1 each |
| Fender cover | 1 each |
| Brake drum and rotor lathe with radius grinding attachment | 1 each |
| Propane carburetor kit | 1 each |
| Hydraulic press | 1 each |
| Universal dial indicator | 1 each |
| Headlight dimming kit | 1 each |

For Emission Control:

| | |
|---|---|
| Infra-red exhause emissions tester | 1 each |

Addendum to Task 1.0-F

| | |
|---|---|
| Catalytic converter aspirator | 1 each |
| Catalytic converter vibrator | 1 each |
| CT-3 PCV Tester | 1 each |

# UNIT 1.0-G

# AUTOMOTIVE MECHANICS

# AUTOMOTIVE FASTENERS

| | | |
|---|---|---|
| UNIT | 1.0-G | AUTOMOTIVE MECHANICS INTRODUCTION - FASTENERS |
| TASK | G.01 | IDENTIFY AND USE AUTOMOTIVE FASTENERS |

---

PERFORMANCE OBJECTIVE:

Given proper instruction, various fasteners used in automotive mechanics, and job situations requiring the use of fasteners; identify, by the proper terminology, the appropriate fasteners for the job and use the fastener properly, meeting manufacturer's specifications and instructor's standards.

NOTE: Orientation Task. Competency will be developed during entire training period.

PERFORMANCE ACTIONS:

G.0101 Identify:

- screws
- bolts
- nuts
- lock washers
- cotterpins
- snap rings
- keys and splines

G.0102 Determine proper fasteners for given situations.

G.0103 Correctly use various tupes of fasteners.

PERFORMANCE STANDARDS:

- Use automotive fasteners correctly in given job situations with 90 percent accuracy.
- Identify on written knowledge test with 80 percent accuracy common automotive fasteners and their purposes.

SUGGESTED INSTRUCTION TIME: 2 Hours

RELATED TECHNICAL INFORMATION:

- Textbooks.
- Manufacturer's catalogs.
- Specifications manuals.
- Metric fasteners.
- Recognize English thread designation system.
- Distinguish between fasteners of different quality with the grade marking system.

# UNIT 1.0-H

# AUTOMOTIVE MECHANICS

# SHOP PRACTICES AND PROCEDURES

| | | |
|---|---|---|
| UNIT | 1.0-H | AUTOMOTIVE MECHANICS - INTRODUCTION |
| TASK | H.01 | SHOP PRACTICES AND PROCEDURES |

---

PERFORMANCE OBJECTIVE:

Given proper instruction concerning standard shop operating procedures, appropriate reference materials, and simulated or typical job situations; choose and use related technical information, such as shop manuals, flat rate manual, manufacturer's specifications, and part catalogs, using the proper terminology and parts requisition forms to the instructor's standards.

PERFORMANCE ACTIONS:

H.0101 Identify and state purpose of shop operating procedures.

H.0102 Use shop operating reference materials: (as applicable)
- a. Shop operating manuals
- b. Charts
- c. Forms and job orders
- d. Flat rate manual
- e. Manufacturer's specifications
- f. Parts manual

H.0103 Demonstrate proper use of common shop terminology.

PERFORMANCE STANDARDS:

- In given shop situation, choose and use most appropriate shop manuals for reference as well as other reference and shop operating procedure guides with 90 percent accuracy, meeting instructor's standards.

SUGGESTED INSTRUCTION TIME: 2 Hours

RELATED TECHNICAL INFORMATION:

- Locate correct service information for an automobile in an owners manual.
- Locate service information labeled on an automobile's engine, etc.

# UNIT 1.0-I

# AUTOMOTIVE MECHANICS

# INTRODUCTION TO AUTOMOTIVE SYSTEMS

UNIT 1.0-I AUTOMOTIVE MECHANICS - INTRODUCTION TO AUTOMOTIVE SYSTEMS

TASK I.01 LUBRICATION AND TIRES

---

PERFORMANCE OBJECTIVE:

Given proper instruction, identify types, purpose, use, and operator care of lubrication items and tires.

PERFORMANCE ACTIONS:

| | |
|---|---|
| I.0101 | Identify purposes and types of lubrication system. |
| I.0102 | Identify major component parts and state purpose in lubrication system. |
| I.0103 | Compare purpose and types of tires. |
| I.0104 | Recognize lubrication and tire tools and equipment. |
| I.0105 | Demonstrate how to perform operator maintenance of lubrication system and tires. |

PERFORMANCE STANDARDS:

- Identify purpose and types and demonstrate use of lubrication system and tire items and demonstrate care of lubrication system and tires with 100 percent accuracy, meeting instructor's standards.

SUGGESTED INSTRUCTION TIME: 3 Hours

RELATED TECHNICAL INFORMATION:

- Appropriate manuals and charts.
- Manufacturer's specifications.

| | | |
|---|---|---|
| UNIT | 1.0-I | AUTOMOTIVE MECHANICS - INTRODUCTION TO AUTOMOTIVE SYSTEMS |
| TASK | I.02 | COOLING SYSTEM |

---

PERFORMANCE OBJECTIVE:

Given proper instruction concerning the operation of the cooling system, identify the purposes of the cooling system, major components and purposes, and perform operator care of cooling system to manufacturer's specifications or to instructor's standards.

PERFORMANCE STANDARDS:

I.0201 Identify purpose and operation of cooling system.

I.0202 Identify and state purpose of major component parts of cooling system.

I.0203 Demonstrate how to perform operator maintenance of cooling system.

PERFORMANCE STANDARDS:

- Identify each major component of system, state purpose of operation, and perform operator maintenance with 90 percent accuracy.

SUGGESTED INSTRUCTION TIME: 3 Hours

RELATED TECHNICAL INFORMATION:

- Appropriate shop manuals.
- Manufacturer's specifications.

| | | |
|---|---|---|
| UNIT | 1.0-I | AUTOMOTIVE MECHANICS - INTRODUCTION TO AUTOMOTIVE SYSTEMS |
| TASK | I.03 | BRAKING SYSTEM |

PERFORMANCE OBJECTIVE:

Given proper instruction concerning automotive braking systems, identify the purpose, operation, major parts of a braking system, and perform operator care of a given braking system.

PERFORMANCE ACTIONS:

| | |
|---|---|
| I.0301 | Identifies purpose and operation of braking system. |
| I.0302 | Identifies major component parts of purpose. |
| I.0303 | Demonstrates how to perform operator maintenance. |

PERFORMANCE STANDARDS:

- Identify each major component of an automobile braking system, stating its purpose and operation, and perform operator maintenance with 100 percent accuracy.

SUGGESTED INSTRUCTION TIME: 3 Hours

RELATED TECHNICAL INFORMATION:

- Maunfacturer's specifications.

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UNIT 1.0-I AUTOMOTIVE MECHANICS - INTRODUCTION TO AUTOMOTIVE SYSTEMS

TASK I.04 FUEL SYSTEMS

---

PERFORMANCE OBJECTIVE:

Given proper instruction, samples of selected major American and foreign automobiles, state the purposes and describe the operation of the fuel system. Identify major parts and identify their purposes; state the types and characteristics of motor fuels; and perform operator maintenance on fuel systems.

PERFORMANCE ACTIONS:

I.0401 Identify purpose and system operation of given automobile fuel system.

I.0402 Identify major component parts of fuel system and their purpose.

I.0403 State types and characteristics of typical motor fuels.

I.0404 Demonstrate how to perform operator maintenance of fuel system.

PERFORMANCE STANDARDS:

- Identify each component of the fuel system, stating its purpose and operation; state types and characteristics of motor fuels, and perform operator maintenance.
- Accuracy must be 80 percent on written knowledge tests and 100 percent on performance test.

SUGGESTED INSTRUCTION TIME: 3 Hours

RELATED TECHNICAL INFORMATION:

- Appropriate shop manuals.
- Manufacturer's specifications.

UNIT 1.0-I AUTOMOTIVE MECHANICS - INTRODUCTION TO AUTOMOTIVE SYSTEMS

TASK I.05 STEERING SYSTEM AND FRONT END

---

PERFORMANCE OBJECTIVE:

Given proper instruction to the automotive steering system and front end, state the purpose and describe the operations of the automotive steering system and front end. Identify and state the purpose of major component parts of the steering system and front end; and demonstrate how to correctly perform operator maintenance, meeting the manufacturer's specifications and the instructor's standards.

PERFORMANCE ACTIONS:

I.0501 Identify the purpose of system operation of the automotive steering system and front end.

I.0502 Identify the major component parts and purpose of the steering system and front end.

I.0503 Demonstrate how to perform operator maintenance on the automotive steering system and front end.

PERFORMANCE STANDARDS:

- Identify each major component part of the steering system and front end, state its purpose and operation, and perform operator maintenance on one or more given automobiles with 80 percent accuracy on written knowledge tests and 100 percent accuracy in performance.

SUGGESTED INSTRUCTION TIME: 2 Hours

RELATED TECHNICAL INFORMATION:

- Appropriate shop manuals.
- Manufacturer's specifications.

UNIT 1.0I AUTOMOTIVE MECHANICS - INTRODUCTION TO AUTOMOTIVE SYSTEMS

TASK I.06 POWER TRAIN AND MANUAL TRANSMISSION

---

## PERFORMANCE OBJECTIVE:

Given proper instruction, orientation to different automobile makes with manual transmission, identify purposes, operation, and major parts of the power train system with manual transmission and perform operator maintenance meeting manufacturer's specifications and instructor's standards.

## PERFORMANCE ACTIONS:

I.0601 State purpose and describe operation of the power train with manual transmission.

I.0602 Identify major component parts and purpose of the power train system.

I.0603 Perform operator maintenance on the power train system and manual transmission.

## PERFORMANCE STANDARDS:

- Identify major component parts of the power training with manual transmission, state its purpose and operation, and perform operator maintenance on the system.
- Accuracy is to be 80 percent on written knowledge tests and 100 percent on performance.
- Adhere to the manufacturer's specifications and meet instructor's standards.

SUGGESTED INSTRUCTION TIME: 6 Hours

## RELATED TECHNICAL INFORMATION:

- Appropriate shop manuals.
- Manufacturer's specifications.

| | | |
|---|---|---|
| UNIT | 1.0-I | AUTOMOTIVE MECHANICS - INTRODUCTION TO AUTOMOTIVE SYSTEMS |
| TASK | I.07 | ENGINE |

---

PERFORMANCE OBJECTIVE:

Given proper instructions and an orientation to the automotive gas engine, state the purpose and describe the operation of the engine, identify the major component parts and state their purposes, and demonstrate how to perform operator maintenance according to manufacturer's specifications and meeting the instructor's standards.

PERFORMANCE ACTIONS:

I.0701 Describe purpose and operation of the automotive engine.

I.0702 Identify the major component parts and purposes of the engine.

I.0703 Describe or demonstrate how to perform operator maintenance.

PERFORMANCE STANDARDS:

- Identify each major component part of the automotive gas engine, state its purpose and operation, and perform operator maintenance with an accuracy of 80 percent on written knowledge tests and 100 percent on performance, meeting manufacturer's specifications and the instructor's standards.

SUGGESTED INSTRUCTION TIME: 6 Hours

RELATED TECHNICAL INFORMATION:

- Shop manuals.
- Parts manuals.
- Manufacturer's specifications.

UNIT 1.0-I AUTOMOTIVE MECHANICS - INTRODUCTION TO AUTOMOTIVE SYSTEMS

TASK I.08 HEATER SYSTEM

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PERFORMANCE OBJECTIVE:

Given a proper orientation, a typical automobile and shop situation to service a heater system, state the purpose and operation of the automotive heater system identify major component parts and state their purpose, and perform operator maintenance on the heater to 90 percent accuracy.

PERFORMANCE ACTIONS:

I.0801 State purpose and operation of heater system.

I.0802 Identify major component parts of heater system and purpose.

I.0803 Demonstrate how to perform operator maintenance of heater system.

PERFORMANCE STANDARDS:

- Identify each major component of the automotive heater system, state its purpose and operation, and perform operator maintenance with 80 percent accuracy on written knowledge tests and 90 percent accuracy on performance tests.

SUGGESTED INSTRUCTION TIME: 2 Hours

RELATED TECHINCAL INFORMATION:

- Appropriate shop manuals and charts.

UNIT 1.0-I AUTOMOTIVE MECHANICS - INTRODUCTION TO AUTOMOTIVE SYSTEMS

TASK I.09 AUTOMATIC TRANSMISSION

---

PERFORMANCE OBJECTIVE:

Given an orientation to the automobile automatic transmission, introduction to typical automatic transmissions, and operator maintenance of transmissions; state purpose and describe operation of the automatic transmission, identify and state the purpose of major component parts, and show how to perform operator maintenance.

PERFORMANCE ACTIONS:

I.0901 Explain purpose and operation of automatic transmission.

I.0902 Identify and give the purpose of major component parts of the automatic transmission.

I.0903 Show how to perform operator maintenance on the automatic transmission.

PERFORMANCE STANDARDS:

- Identify each major component part of the automatic transmission, state its purpose and operation with an accuracy of 80 percent on a written knowledge test and perform operator maintenance with 100 percent accuracy.

SUGGESTED INSTRUCTION TIME: 2 Hours

RELATED TECHNICAL INFORMATION:

- Appropriate shop manuals.

UNIT 1.0-I AUTOMOTIVE MECHANICS - INTRODUCTION TO AUTOMOTIVE SYSTEMS

TASK I.10 ELECTRICAL SYSTEM

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PERFORMANCE OBJECTIVE:

Given proper orientation to the automotive electrical system, state the purpose and describe the operation of the automobile electrical system, identify and state the purpose of major component parts, and show how to perform operator maintenance.

PERFORMANCE ACTIONS:

I.1001 Describe the purpose and operation of the automotive electrical system.

I.1002 Identify the major component parts and their purposes.

I.1003 Show how to perform operator maintenance.

PERFORMANCE STANDARDS:

- Identify each major component part of the automobile electrical system, stating its purpose and operation, with 80 percent accuracy on written knowledge tests, and 100 percent accuracy on demonstrated operator maintenance.

SUGGESTED INSTRUCTION TIME: 6 Hours

UNIT 1.0-I AUTOMOTIVE MECHANICS - INTRODUCTION TO AUTOMOTIVE SYSTEMS

TASK I.11 AIR CONDITIONERS

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PERFORMANCE OBJECTIVE:

Given an orientation to the automobile air conditioning system, typical manufacturer systems, state the purpose and describe the operation of the automobile air conditioner, identify and state the purpose of major component parts of the air conditioner, and show how to perform operator maintenance.

PERFORMANCE ACTIONS:

I.1101 Describe the purpose and operation of the automobile air conditioner system.

I.1102 Identify major component parts of the system and state their purpose.

I.1103 Show how to perform operator maintenance.

PERFORMANCE STANDARDS:

- Identify each major component part of the air conditioner system, state its purpose and operations, with 80 percent accuracy on written knowledge tests, and show how to perform operator maintenance with 90 percent accuracy.

SUGGESTED INSTRUCTION TIME: 1 Hour

RELATED TECHNICAL INFORMATION:

- Shop manuals.
- Manufacturer's specifications and manuals.

## TASK LISTINGS
## AUTOMOTIVE MECHANICS

| UNIT/TASK | DESCRIPTION |
|---|---|
| UNIT 2.0 | LUBRICATION AND VEHICLE OPERATING MAINTENANCE - LEVEL I |
| 2.01 | (Automotive Tune-up and Repair Draining & Refilling Engine Oil) Given an automobile, the student will drain the engine oil and refill it to a specified level with lubricant recommended by the manufacturer for specified vehicle use. |
| 2.02 | (Automotive Tune-up and Repair Changing Oil Filter Cartridge) Given an automobile, the student will change the oil filter cartridge in accordance with given procedures. |
| 2.03 | (Automotive Tune-up and Repair Chassis Lubrication) Given an automobile, the student will perform a chassis lubrication using the specified lubricants in accordance with manufacturer's specifications. |
| 2.04 | (Inspect, Service, or Replace Carburetor Air Cleaner) Given a vehicle and access to the necessary hand tools, equipment, and a service manual; inspect the carburetor air cleaning element for dirt, and clean the element, using the manufacturer's recommended procedures. |

UNIT 2.0 LUBRICATION AND VEHICLE OPERATING MAINTENANCE - LEVEL I

TASK 2.01 DRAIN & REFILL ENGINE OIL

---

PERFORMANCE OBJECTIVE:

Given an automobile, the student will drain the engine oil and refill it to a specified level with lubricant recommended by the manufacturer for specified vehicle use.

PERFORMANCE ACTIONS:

2.0101 Run engine until oil is hot.

2.0102 Raise car on hoist.
(CAUTION: Follow hoist safety rules.)

2.0103 Place oil drain pan under drain plug.

2.0104 Remove oil drain plug.
(CAUTION: Be careful of hot oil.)
(NOTE: Do not drop plug into drain pan.)

2.0105 Allow oil to drain until all oil is out.

2.0106 Replace drain plug.
(CAUTION: Do not overtighten.)
(NOTE: If filter is to be changed, refer to Job Sheet No. 16.)

2.0107 Lower car to floor.

2.0108 Refer to specifications for amount, type, and grade of oil to be used.

2.0109 Remove filler cap.

2.0110 Put in specified oil.
(NOTE: Be careful--do not spill oil on fender or engine.)

2.0111 Check oil level on dipstick.
(NOTE: Dipstick should show "full.")

2.0112 Start engine and check for oil pressure.
(NOTE: If no pressure, stop engine and check with instructor.)

PERFORMANCE ACTIONS (Con't.):

2.0113 Turn engine off.

2.0114 Raise car and check drain plug for leaks. (NOTE: If plug leaks, check with instructor.)

2.0115 Lower car to floor.

2.0116 Record mileage on vehicle lubrication sticker.

2.0117 Clean up work area. Place empty oil cans in designated trash container.

PERFORMANCE STANDARDS:

- Drain and fill the engine oil to manufacturer's specifications using proper weight and quality of oil. No leaks.

SUGGESTED INSTRUCTION TIME: 1 Hour

RELATED TECHNICAL INFORMATION:

- Identify oil filters, drain plugs, filler caps, and dip stick.
- Describe viscosity or pepoerty of oils.
- Identify different type filters.
- Manufacturer's specifications.

UNIT 2.0 LUBRICATION AND VEHICLE OPERATING MAINTENANCE - LEVEL I

TASK 2.02 CHANGE OIL FILTER CARTRIDGE

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PERFORMANCE OBJECTIVE:

Given an automobile, the student will change the oil filter cartridge in accordance with given procedures.

PERFORMANCE ACTIONS:

2.0201 Start engine and bring engine to operating temperature.

2.0202 Hold hand on oil filter.
(NOTE: If filter feels cold it is completely clogged. If it feels hot and oil is still flowing through.)

2.0203 Remove the filter cover and lift out filter element. Put it in the funnel on the oil drum.
(NOTE: Do not drop oil all over shop floor.)

2.0204 Use a suction gun to remove rest of oil from filter case.

2.0205 Wipe interior of case clean and wash filter top clean.

2.0206 Read instructions with new filter. Install new filter in filter case.

2.0207 Start engine and check all around filter for leaks.

2.0208 Replace the filter case cover and gasket. Tighten the cover clamp nut (or rim bolts).

2.0209 Add one quart of motor oil to the crankcase. (This allowance is for the capacity of the filter and must be added to engine oil whenever a filter cartridge is renewed.)
(NOTE: Do not put oil in the filter case.)

2.0210 Run the engine for a few minutes and check for oil leaks.

PERFORMANCE STANDARDS:

- Change the oil filter cartridge to manufacturer's specifications, using the proper filter and tightening so there are no leaks.

UNIT 2.0 LUBRICATION AND VEHICLE OPERATING MAINTENANCE - LEVEL I

TASK 2.02 CHANGE OIL FILTER CARTRIDGE (Con't.)

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SUGGESTED INSTRUCTION TIME: 1 Hour

RELATED TECHNICAL INFORMATION:

- Manufacturer's specifications.

UNIT 2.0 LUBRICATION AND VEHICLE OPERATING MAINTENANCE - LEVEL I

TASK 2.03 CHASSIS LUBRICATION

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PERFORMANCE OBJECTIVE:

Given an automobile, the student will perform a chassis lubrication using the specified lubricants in accordance with manufacturer's specifications.

PERFORMANCE ACTIONS:

2.0301 Raise car on hydraulic lift according to safety instructions for that lift.

2.0302 Consult lubrication chart for the particular vehicle being lubricated.
(NOTE: Location and total number of grease fittings.)

2.0303 Wipe all grease fittings clean with a shop rag.

2.0304 Place lube gun on each fitting and apply pressure. Continue pressure until new, clean, grease can be seen coming out of joint.

2.0305 Lube all rubber grommets with rubber lube only.
(NOTE: Do not use oil or grease on rubber. It will cause deterioration.)

2.0306 Remove differential oil filler plug and check lube level.
(NOTE: Lube should be up to where it almost runs out of hole. Add specified gear lube if necessary.)

2.0307 Check lube level of standard transmission following manufacturer's recommended procedure for standard transmission.

2.0308 Lube emergency brake linkage and clutch, with SAE 30 oil.

2.0309 Check and lube universal joints following manufacturer's recommended procedure.
(NOTE: Many universal joints should not be lubed with pressure gun.)

2.0310 If in doubt about your work, have instructor check it at this point.

UNIT 2.0 LUBRICATION AND VEHICLE OPERATING MAINTENANCE - LEVEL I

TASK 2.03 CHASSIS LUBRICATION (Con't.)

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PERFORMANCE ACTIONS (Con't.):

2.0311 Lower car to floor and raise hood.

2.0312 Lube generator, starter, and distributor at oil cups with about 3 drops of SAE 30 oil.

2.0313 Lube fan belt by rubbing fan belt lube on underside of fan belt.
(CAUTION: Do not try this while engine is running.)

2.0314 Check the steering gear case fluid level and add 90 wt. gear lube if necessary.

2.0315 Clean all grease fittings under hood and lube with pressure gun.

2.0316 Lube throttle linkage with SAE 30 oil.

2.0317 Lube door latches, door catches, hood release, and trunk latch with stick lubricant.
(NOTE: Apply lubricant to the surfaces that rub on each other.)

2.0318 Check manufacturer's manual to see how and if water pump should be lubricated.

2.0319 Put graphite in door locks.

2.0320 Check brake fluid level and add if necessary 1/4 inch from top of filler hole.

2.0321 Close hood and remove car from hoist.

PERFORMANCE STANDARDS:

- Lubricate the chassis using the lubricants recommended by manufacturer.
- Wipe down all fittings prior to lubrications and clean all fittings of excess grease after lubrication.

SUGGESTED INSTRUCTION TIME: 1 Hour

UNIT 2.0 LUBRICATION AND VEHICLE OPERATING MAINTENANCE - LEVEL I

TASK 2.04 INSPECT, SERVICE, OR REPLACE CARBURETOR AIR CLEANER

---

PERFORMANCE OBJECTIVE:

Given a vehicle and access to the necessary hand tools, equipment, and a service manual; inspect the carburetor air cleaning element for dirt, and clean the element, using the manufacturer's recommended procedure.

PERFORMANCE ACTIONS:

2.0401 Remove carburetor air filter element. (Use of fender covers recommended.)

2.0402 Inspect filter element for dirt. (Visually with light bulb or against sunlight.)

2.0403 Remove excess dirt from filter, if necessary.

2.0404 Replace filter or reinstall filter.

PERFORMANCE STANDARDS:

- Inspect and clean or replace the carburetor air cleaner on the vehicle provided by the instructor.
- Standard's of industry on replacement of air filter apply.

SUGGESTED INSTRUCTION TIME: 1 Hour

# TASK LISTINGS
## AUTOMOTIVE MECHANICS

| UNIT/TASK | DESCRIPTION |
|---|---|
| Unit 3.0 | AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL |
| 3.01 | (Determine Needed Engine Service or Repair) Given an automobile with a possible engine problem, determine the needed engine service or repair, as accurately as possible using given and available information. Report findings to customer. |
| 3.02 | (Perform Engine Vacuum Tests and Determine Needed Repairs) Given a vacuum gauge, the student will diagnosis the engine condition using the vacuum gauge in accordance with given specifications. |
| 3.03 | (Replace Valve Cover Gaskets) Given an automobile and access to the proper hand tools and equipment. Student will remove and replace valve cover gasket(s). Upon replacement, there will be no leaks or stoppages in the system. |
| 3.04 | (Replace Outside Seals) Given an automobile engine out of a car, the student will install the rear-main seal in accordance with manufacturer's specifications. |
| 3.05 | (Replace and Repair Motor Mounts) Provided a vehicle and access to the proper hand tools, equipment, and service manual; replace the engine mounts following the manufacturer's recommended procedures. The mounts must meet the manufacturer's torque specifications where necessary. |
| 3.06 | (Perform Cylinder Compression Tests and Determine Needed Repairs) Provided an engine at normal operating temperatures, and using the proper tools, gauges, and service manual; perform a cylinder compression test within +/- 10 p.s.i. of the readings found by the instructor. |
| 3.07 | (Remove Cylinder Head(s) From Engine) Given an engine, the student will remove the cylinder head(s) according to manufacturer's specifications. |
| 3.08 | (Diassembling a Cylinder Head) Given a cylinder head, the student will disassemble it. |
| 3.09 | (Inspect Valve Spring Retainers and Locks) Given an automobile engine, the student will test the valve spring for etchings, squareness, uniformity, and specified compressed pressure at a specified height. |
| 3.10 | (Inspect Valve Guides for Wear, Check Valve Guide to Stem Fit, and Determine Needed Repairs) Given an automotive cylinder head engine, the student will determine valve stem to guide clearance and compare with manufacturer's specifications. |

3.11 (Inspect Cylinder Heads for Cracks, Gasket Surface Areas for Warpage, and Check Passage Condition) Given a cylinder head, and access to the proper equipment and service manual, inspect the head for warpage, under the supervision of an instructor. If warpage exists, report the findings to the instructor and identify the necessary repairs.

3.12 (Reassembling Valve Components With Head) Given an automobile engine, the student will reassemble the valve components with the head in accordance with manufacturer's specifications.

3.13 (Installing Cylinder Heads on Engine Block) Given an automobile engine the student will install the cylinder heads on the engine block in accordance with manufacturer's specifications.

3.14 (Steam Clean Engine) Using a steam cleaner, steam clean the engine surface of a given automobile under the instructor's supervision. All heavy deposits of dirt and grease must be dissolved and washed away, and ignition parts must be free of moisture.

3.15 (Inspect Exhaust System) Provided a vehicle, visually check the complete exhaust system for holes, defects, broken or missing components, and rust-outs, under instructor supervision. All defects and problem identified by the instructor must be recognized.

3.16 (Replace Exhaust Manifold(s)) Given an automobile with broken or warped exhaust manifolds, and access to the proper tools, equipment, and service manual; remove and install new exhaust manifold, following the manufacturer's procedures. When completed, the exhaust manifold will not leak fumes or rattle.

3.17 (Testing a Positive Crankcase Ventilation System) Given a pressure tester and a positive crankcase ventilation system, the student will test the system using the pressure tester in accordance with manufacturer's specifications.

3.18 (Perform Cylinder Leakage Tests and Determine Needed Repairs) Given an engine at normal operating temperatures and using the proper tools, equipment, and service manual; perform a cylinder leakage test following the manufacturer's recommended procedures. The reading must be within +/- 10 percent of the reading found by the instructor.

3.19 (Perform Cylinder Power Balance Tests and Determine Needed Repairs) Given an engine at normal operating temperatures, and using the proper test equipment, and service manual; perform a cylinder balance test under instructor supervision. Time limit is 20 minutes. The reading must be within +/- 10 percent of the reading found by the instructor.

3.20 (Diagnose Valve Train and Head Malfunctions) Using the proper tools and equipment, examine the valve train and head of an operating engine and identify the malfunctions, under instructor's supervision. All malfunctions given by the instructor must be identified.

3.21 (Clean Engine Parts and Check for Condition) With the engine disassembled, and using the proper cleaning equipment, clean and inspect each engine component for proper condition, under instructor supervision. All components needing maintenance and repair must be identified to the instructor, and each cleaned part must meet instructor's approval.

3.22 (Perform Operational Inspections of the Engine Lubrication Systems) Given an automobile, service manual, and access to the proper tools, and gauges; perform operational inspections of the engine lubrication systems following the manufacturer's recommended procedures. All malfunctions (stoppages) identified by the instructor must be recognized.

3.23 (Replace Camshaft, Replace Camshaft Bearings, Replace Timing Gears and Chains, Replace Gaskets and Seals, Replace Valve Lifters) Given an automobile engine and access to the proper tools, equipment, and service manual; remove and replace the camshaft in accordance with the manufacturer's specifications and procedures. Camshaft and related component parts will work freely without binding or leakage upon completion of the repairs.

3.24 (Repair and Replace Intake Manifold and Gaskets) Given an automobile engine, the student will remove and replace the intake manifold in accordance with manufacturer's specifications.

3.25 (Adjust Valves) Given automobile engine with mechanical valve lifters, necessary tools, equipment, and service manual; adjust exhaust and intake valve "lash" according to the manufacturer's specifications and method. Any variations must be detected and corrected.

3.26 (Inspect, Replace and/or Grind Valve Face and Stem) Given an cylinder head, the student will grind the valve face and stem using valve machine in accordance with manufacturer's specifications.

3.27 (Refacing Valve Seats) Given an cylinder head, the student will reface the valve seats using a valve seat grinder and maintaining a concentricity of .002 inch.

3.28 (Knurl Valve Guide) Given cylinder head(s) totally disassembled, and proper tools and equipment, students will be able to knurl valve guides to a correct fit.

3.29 (Remove and Replace Oil Pump) Provided an engine, and given access to a service manual and proper hand tools, replace the oil pump following the manufacturer's recommended procedures. Operation of the oil pump after installation must meet manufacturer's specifications and must have no leaks or other malfunctions.

3.30 (Replace Flywheel and Flywheel Ring Gear) Provided a vehicle, service manual and access to the proper tools and equipment, replace the flywheel ring gear and flywheel, following the manufacturer's specifications and procedures. When completed, the flywheel ring gear will function without noise or slippage.

3.31 (Remove and Replace Engine from Vehicle) Given an automobile requiring engine removal, and access to a engine hoist, or chain hoist, service manual, hand tools, and other needed equipment, remove the engine from the vehicle following the manufactuer's recommended procedures. The engine must be removed without incurring any damage to surrounding items and equipment. All accepted safety practices must be observed.

3.32 (Remove and Replace Connecting Rods and Bearings, Remove and Replace Pistons and Rings, and Inspect Parts with Micrometers and Plastigauge) Using the proper hand tools and service manual; remove and replace the connecting rods and rod bearings in a given engine, accoridng to manufacturer's specifications. Upon completion, there will be no leaks in the repaired area and the oil pressure and engine temperature will conform to the manufacturer's specifications.

3.33 (Remove and Replace Crankshaft and Bearings, Inspect with Micrometers and Plastigauge for Proper Bearing Fit) Given an assigned crankshaft and block assembly, and using the proper tools, equipment, and service manual; replace the crankshaft and main bearings according to the manufacturer's procedures and specifications.

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.01 DIAGNOSE NEEDED ENGINE SERVICE OR REPAIR

---

## PERFORMANCE OBJECTIVE:

Given an automobile with a possible problem, diagnose the needed engine service or repair, as accurately as possible using given and available information. Report findings to customer.

## PERFORMANCE ACTIONS:

3.0101 Listen to driver's (owner's) complaint.

3.0102 Listen to engine noises, or observe performance problem.

3.0103 Inspect engine assembly for fuel, oil, collant, transmission, or other leaks.

3.0104 Check engine systems as necessary. For example, check engine exhaust smoke color and quality.

3.0105 Road test vehicle to determine needed repairs/service.

3.0106 Determine needed repairs/service. Report to customer.

## PERFORMANCE STANDARDS:

- Determine needed engine service or repair based on given and available information.
- Findings must agree with pre-diagnosed or instructor findings.

SUGGESTED INSTRUCTION TIME: 1 Hour

(NOTE: Diagnostic competency typically will require training and experience over a period of time exceeding the "suggested instructional times." (Competency may require the full two year training period to develop.)

## SUGGESTIONS FOR ROAD TESTING VEHICLE

1. Observe all traffic laws.
2. Drive to location where it is safe to accelerate to 50 MPH.
3. On reaching 50 MPH, immediately let up on accelerator. Allow car to coast to about 30 MPH.
4. Drive at 30 MPH for about a block. Then, accelerate rapidly to 50 MPH and again let up on acceleration and coast to about 30 MPH. (Repeat as necessary.)
5. Observe for reported engine problem.
6. Observe oil pressure, temperature, steering, braking, shifting, clutch, rear axle, as well as engine performance.
7. Engine should have had smooth and responsive, ping-free acceleration. There should be missing, bucking, or loping at low, medium, and high speeds. The engine should not stall following a fast stop. Dash instruments should read normal.
8. It is advisable to check horn, lights, or other systems and make the customer aware of all areas that may need repairs.

## SOME AREAS TO OBSERVE ARE

1. Oil pressure: low, excessive, no pressure, contamination, consumption.
2. Overheating, overcooling or slow warmup, belt squeal on acceleration, or at idle, noisy water pump, radiator cap noise, coolant loss.
3. Stalling and/or rough idling, carburetor flooding, poor acceleration, idle speed varies, hard starting when cold or hot, excessive fuel consumption, or insufficient or excessive fuel delivery, improper choking, top speed lowered, fuel pump noise.
4. Missing during acceleration or at idle or low speed, missing during crusing or high speed operation, missing at all speeds, preignition, detonation, backfiring in intake manifold or exhaust system, engine kicks (backward) during cranking, weak or intermittent or no spark at plugs, short point life, coil failure, condenser failure, short spark plug life.
5. No charge, low or erratic rate of change, excessive charge, noise in charging system.
6. Undercharged battery, overcharged battery, regular diagnosed as malfunction.
7. Starter will not crank engine, starter cranks engine slowly, starter makes excessive noise, starter cranks but will not engage flywheel ring gear, starter drive pintion releases slowly or not at all.

Source of these suggestions: Auto Service and Repair by Stockel.

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.02 PERFORM ENGINE VACUUM TESTS AND DETERMINE NEEDED REPAIRS

---

## PERFORMANCE OBJECTIVE:

Given a vacuum gauge, the student will diagnosis the engine condition using the vacuum gauge in accordance with given specifications.

## PERFORMANCE ACTIONS:

3.0201 Remove the vacuum plug at base plate of carburetor.

3.0202 Connect the adaptor on gauge on the manifold.

3.0203 Start the engine and set idle at 400 to 500 rpm.

3.0204 Check for appropriate readings.

3.0205 Record test results.

3.0206 Write findings from tests on reverse side of Job Sheet.

## PERFORMANCE STANDARDS:

- Diagnose engine condition using the vacuum gauge and given specifications. Finding must agree with instructors.

SUGGESTED INSTRUCTION TIME: 1 Hour

## RELATED TECHNICAL INFORMATION:

- Interpreting standard vacuum gauge readings.

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.03 REPLACE VALVE COVER GASKETS

---

PERFORMANCE OBJECTIVE:

Given an automobile and access to the proper hand tools and equipment. Student will remove and replace valve cover gasket(s). Upon replacement, there will be no leaks or stoppage in the system.

PERFORMANCE ACTIONS:

3.0301 Remove air cleaner.

3.0302 Remove any wires, brackets, vacuum lines, etc., to gain access to valve covers.

3.0303 Remove valve cover attaching (bolts and screws).

3.0304 Tap valve cover with rubber hammer to break loose and remove valve cover.

3.0305 Scrap old gasket from valve cover and clean cover and head thoroughly.

3.0306 Inspect and clean if necessary oil return passages.

3.0307 Inspect valve cover gasket surface area and reshape if necessary.

3.0308 If using gasket sealer, please only on valve cover side of gasket and install gasket on valve cover.

3.0309 Reinstall valve cover(s) on engine.
(NOTE: Check for loose wires or hoses, etc., trapped under cover.)

3.0310 Retorque bolts-screws to manufacturer's specifications.

3.0311 Repeat steps 1 and 2 in reverse and start engine and check for oil leaks.

PERFORMANCE STANDARDS:

- Remove and replace valve cover gasket(s). Upon completion, there will be no leaks or stoppage in the system.

SUGGESTED INSTRUCTION TIME: 5 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.04 REPLACE OUTSIDE SEALS

---

PERFORMANCE OBJECTIVE:

Given an automobile engine out of a car, the student will install the rear-main oil seal in accordance with manufacturer's specifications.

PERFORMANCE ACTIONS:

3.0401 Compare old seal with new seal for proper fit.

3.0402 Clean seal groove in cap and block with cloth and scraper.

3.0403 Press braided seal into cap so that both ends stick up above cap.

3.0404 Tap or roll the seal down into the groove using a smooth rounded tool like a hammer handle.

3.0405 Check to make sure it is snugly in place.

3.0406 Cut off ends flush with cap with razor blade and set aside.

3.0407 Repeat same procedure in the block section.

PERFORMANCE STANDARDS:

- Install rear-main oil seal in accordance with manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.05 REPLACE MOTOR MOUNTS

---

PERFORMANCE OBJECTIVE:

Provided a vehicle and access to the proper hand tools, equipment, and service manual; replace the engine mounts following the manufacturer's recommended procedures. The mounts must meet the manufacturer's torque specifications where necessary.

PERFORMANCE ACTIONS:

3.0501 Refer to manufacturer's service information on procedures.

3.0502 Support engine weight with hydraulic jacks or stands to remove load from engine mounts.

3.0503 Unbolt and remove old engine mounts.

3.0504 Trim rubber from bolt holes in new motor mounts.

3.0505 Install new engine mounts and lower engine to original position.

3.0506 Torque engine mount bolts to specifications.

PERFORMANCE STANDARDS:

- Replace motor mounts following manufacturer's recommended procedures.
- Torqued to specifications where appropriate.

SUGGESTED INSTRUCTION TIME: 8 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.06 PERFORM CYLINDER COMPRESSION TESTS AND DETERMINE NEEDED REPAIRS

---

Provided an engine at normal operating temperatures, and using the proper tools, gauges, and service manual, perform a cylinder compression test within +/- 10 p.s.i. of the readings found by the instructor.

PERFORMANCE ACTIONS:

3.0601 Check battery charge.
(NOTE: Battery must be fully charged before taking compression test.)

3.0602 Remove all spark plugs.

3.0603 Remove coil secondary wire and ground to engine.

3.0604 Fix throttle in wide-open position.

3.0605 Install compression gauge and turn engine over a minimum of four times. Note readings.

3.0606 Repeat for each cylinder.

3.0607 Reinstall spark plugs, spark plug wires, coil secondary wire and close throttle.

PERFORMANCE STANDARDS:

- Make cylinder compression test and determine needed repairs.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.07 REMOVE CYLINDER HEAD(S) FROM ENGINE

---

PERFORMANCE OBJECTIVE:

Given an engine the student will remove the cylinder head(s) according to manufacturer's specifications.

PERFORMANCE ACTIONS:

3.0701 Drain water. Remove distributor cap and mark rotor direction by scraping a mark on firewall or manifold.

3.0702 Remove intake and exhaust manifold. Take extra care in removing the temperature gauge sending unit.

3.0703 Remove the spark plugs with the use of the spark plug tool.

3.0704 Remove the valve covers, the old valve cover gaskets.

3.0705 Remove the rocker arm assembly. Keep the assembly in the exact order it was when removed. Remove the push rods and keep them in order.

3.0706 Remove the cylinder heads. Use 1/2" drive socket set. Remove old head gaskets and mark right and left bank on proper heads. Cover engine block to prevent foreign matter from getting into water channels. Valley and open cylinder.

3.0707 Steam clean head to facilitate further disassembly.

PERFORMANCE STANDARDS:

- Remove cylinder head from engine following proper (manufacturer's) procedures.

SUGGESTED INSTRUCTION TIME: 12 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.08 DISASSEMBLING A CYLINDER HEAD

---

PERFORMANCE OBJECTIVE:

Given a cylinder head, the student will disassemble it.

PERFORMANCE ACTIONS:

3.0801 Remove valve spring keepers using the valve spring compressor. Place keepers in small box.

3.0802 Remove valve springs and valve spring retainers. Place them in boxes.

3.0803 Remove valves and place them in their proper place on the valve board.

PERFORMANCE STANDARDS:

- Disassemble cylinder head following correct procedures, correctly cleaning and storing each part.

SUGGESTED INSTRUCTION TIME: 3 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.09 INSPECT VALVE SPRING RETAINERS AND LOCKS

---

PERFORMANCE OBJECTIVE:

Given an automobile engine, the student will test the valve spring for etchings, squareness, uniformity, and specified compressed pressure at a specified height.

PERFORMANCE ACTIONS:

3.0901 Clean springs thoroughly.

3.0902 Check springs for etching. Etching is the result of corresive acids eating away at valve springs. If springs are etched, discard.

3.0903 Use a tri-square and surface plate to examine the squareness of the springs.

3.0904 Line all the springs up on a flat surface, side by side, to check for uniformity. Discard any irregular springs.

3.0905 Using the valve spring tester, test the spring for uniform and specified strength.

3.0906 Visual inspect of valve springs and locks, replace as necessary.

PERFORMANCE STANDARDS:

- Inspect valve spring retainers and locks for etchings, squareness, uniformity, and specified compressed pressure at a specified height. Irregular springs will be replaced.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.10 INSPECT VALVE GUIDES FOR WEAR, CHECK VALVE GUIDE TO STEM FIT, AND DETERMINE NEEDED REPAIRS

---

PERFORMANCE OBJECTIVE:

Given an automotive cylinder head engine, the student will determine valve stem to guide clearance and compare with manufacturer's specifications.

PERFORMANCE ACTIONS:

3.1001 Clean out carbon and varnish (use an adjustable valve guide cleaner).

3.1002 Inspect valve guides for cracks.
(NOTE: If cracked or defective, they must be removed and replaced.)

3.1003 The procedure for checking valve stem to guide clearance will depend on the measuring device used.
a. A dial indicator set up to measure valve guide wear.
b. A small hole gauge and micrometer.

3.1004 Check for wear. If stem to guide clearance exceeds specified maximum clearance by .002", make adjustments according to repair manual.

PERFORMANCE STANDARDS:

- Determine valve stem to guide clearance and compare with manufacturer's specifications. Adjust or replace as necessary.

SUGGESTED INSTRUCTION TIME: 1 Hour

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.11 INSPECT CYLINDER HEADS FOR CRACKS, GASKET SURFACE AREAS FOR WARPAGE, AND CHECK PASSAGE CONDITION

---

## PERFORMANCE OBJECTIVE:

Given a cylinder head, and access to the proper equipment and service manual, inspect the head for warpage, under the supervision of an instructor. If warpage exists, report the findings to the instructor and identify the necessary repairs.

## PERFORMANCE ACTIONS:

3.1101 Clean cylinder head thoroughly.

3.1102 Check for burrs, rough spots and/or cracks.

3.1103 Place long straight edge against sealing surface of head.
  a. Diagonally from corner to corner.
  b. Horizontally along entire length.

3.1104 Measure any open spaces with feeler gauge and refer to manufacturer's specifications for tolerances.

## PERFORMANCE STANDARDS:

- Inspect cylinder heads, measuring open spaces for manufacturer's specifications.
- Repaired cylinder heads will be free of burrs, rough spots, or cracks, will have clean passages and be free of warpage.

SUGGESTED INSTRUCTION TIME: 3 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.12 REASSEMBLING VALVE COMPONENTS WITH HEAD

---

PERFORMANCE OBJECTIVE:

Given an automobile engine, the student will reassemble the valve components with the head in accordance with manufacturer's specifications.

PERFORMANCE ACTIONS:

3.1201 Organize the valves and heads:
a. Place the valves in their proper seats.
b. Slip oil seals onto the valve stem.
c. Place valve spring and spring seat into its position.
(NOTE: Place valve spring in correct place.)

3.1202 Obtain C-shaped valve spring compressor:
a. Compress springs.
b. Insert retainer locks.
c. Using rules and specifications measure install height of each valve spring and stem.
(NOTE: Install valve spring in proper position.)

3.1203 Check spring heights with ruler measure installed spring height.

PERFORMANCE STANDARDS:

- Reassemble valve components with head according to manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE REPAIR, AND OVERHAUL

TASK 3.13 INSTALLING CYLINDER HEADS ON ENGINE BLOCK

---

PERFORMANCE OBJECTIVE:

Given an automobile engine, the student will install the cylinder heads on the engine block in accordance with manufacturer's specifications.

PERFORMANCE ACTIONS:

3.1301 Check surface or block:
- a. Check new head gasket for size. Be sure all water passages and bolt holes are unobstructed.
- b. If burrs are present on block or head surface, remove them with a medium file.
- c. Apply thin coat of gasket cement to each side of the head gasket.
- d. Always install a new gasket as the old one may leak even though it appears to be perfect.

3.1302 Line the gasket up on the block. Before installing gasket allow cement to become tacky.

3.1303 Install head. Do not allow open valves to strike blocks as this may bend them.

3.1304 Torque heads. Specifications can be found in Motor's Manual.

PERFORMANCE STANDARDS:

- Install cylinder heads on a given engine block according to manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 6 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.14 STEAM CLEAN ENGINE

---

PERFORMANCE OBJECTIVE:

Using a steam cleaner, steam clean the engine surface of a given automobile under the instructor's supervision. All heavy deposits of dirt and grease must be dissolved and washed away, and ignition parts must be free of moisture.

PERFORMANCE ACTIONS:

3.1401 Obtain cleaning equipment and cleaning solvent.

3.1402 Refer to equipment manufacturer's specifications and procedures for steam cleaning the engine.

3.1403 Protect distributor and carburetor by covering with water-proof material.

3.1404 Clean engine.

3.1405 Dry as needed (where applicable).

3.1406 Protect against rust (where applicable) with the proper antirust agent.

3.1407 Start engine and check for any malfunctions occurring due to moisture or foreign particles in the operational parts.

PERFORMANCE STANDARDS:

- Steam clean a given engine or engine surface so that all heavy deposits of dirt and grease are dissolved and washed away and the ignition, alternator, or other moisture sensitive parts are not wet.
- Meet instructor's standards.

SUGGESTED INSTRUCTION TIME: 4 Hours

| | | |
|---|---|---|
| UNIT | 3.0 | AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL |
| TASK | 3.15 | INSPECT EXHAUST SYSTEM |

---

PERFORMANCE OBJECTIVE:

Provided a vehicle, visually check the complete exhaust system for holes, defects, broken or missing components, and rust-outs, under instructor supervision. All defects and problem identified by the instructor must be recognized.

PERFORMANCE ACTIONS:

3.1501 Raise car and place on jack stands.

3.1502 Inspect entire exhaust system for leaks, rattles, looseness, holes, rusting, gaskets, and hangers, and clamps.

PERFORMANCE STANDARDS:

- Inspect exhaust system for holes, defects, broken or missing components, and rust-outs identifying with 100 percent accuracy those defects diagnosed by the instructor.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.16 REPLACE EXHAUST MANIFOLD(S)

---

## PERFORMANCE OBJECTIVE:

Given an automobile with broken or warped exhaust manifolds, and access to the proper tools, equipment, and service manual, remove and install new exhaust manifolds, following the manufacturer's procedures. When completed, the exhaust manifold will not leak fumes or rattle.

## PERFORMANCE ACTIONS:

3.1601 Disconnect battery cable.

3.1602 Raise vehicle and place on safety stands.

3.1603 Disconnect exhaust pipe and then lower vehicle.

3.1604 Remove exhaust manifold(s).

3.1605 Free and lubricate heat riser where applicable.

3.1606 Scrape old gaskets (where gaskets are used) from mating service.

3.1607 Replace gaskets and manifold.

3.1608 Raise vehicle and connect exhaust pipes.

3.1609 Connect battery cable.

3.1610 Operate engine and check for leaks and rattles.

## PERFORMANCE STANDARDS:

- Remove and install new exhaust manifolds, following manufacturer's procedures. Upon completion, the exhaust manifold will not leak fumes or rattle.

SUGGESTED INSTRUCTION TIME: 12 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.17 TESTING A POSITIVE CRANKCASE VENTILATION SYSTEM

---

PERFORMANCE OBJECTIVE:

Given a pressure tester and a positive crankcase ventilation system, the student will test the system using the pressure tester in accordance with manufacturer's specifications.

PERFORMANCE ACTIONS:

3.1701 Remove breather cap.

3.1702 Place pressure gauge firmly over breather opening.

3.1703 Start engine and run at idle rpm.

3.1704 Read indicator on gauge.
(NOTE: Green--valve is good. Red--valve is bad.)

3.1705 Remove gauge and replace breather cap.

PERFORMANCE STANDARDS:

- Test a positive crankcase ventilation system using a pressure tester or procedure acceptable to the instructor meeting manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.18 PERFORM CYLINDER LEAKAGE TESTS AND DETERMINE NEEDED REPAIRS

---

PERFORMANCE OBJECTIVE:

Given an engine at normal operating temperatures and using the proper tools, equipment, and service manual, perform a cylinder leakage test following the manufacturer's recommended procedures. The reading must be within +/- 10 percent of the reading found by the instructor.

PERFORMANCE ACTION:

3.1801 Remove spark plugs, air cleaner, crankcase oil filler cap and radiator cap.

3.1802 Set throttle to wide-open position.

3.1803 Determine top dead center position of number one cylinder and all others.

3.1804 Connect cylinder leakage tester to hose number one cylinder.

3.1805 Disconnect coil secondary wire and ground to engine.

3.1806 Apply air pressure to cylinder under test.

3.1807 Check level of percentage of air leakage on gauge.

3.1808 Listen at carburetor, radiator, and tailpipe for air noises.

3.1809 Determine whether leakage is in intake valve, exhaust valve, head gasket or cylinder head.

3.1810 Repeat test for each successive cylinder.

PERFORMANCE STANDARDS:

- Perform cylinder leakage test following manufacturer's recommended procedures.
- Readings must be within +/- 1 percent of instructor's reading.
- Determine needed repairs.

SUGGESTED INSTRUCTION TIME: 3 Hours

UNIT 3.0 AUTOMOTIVE MECHANICS MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.19 PERFORM CYLINDER POWER BALANCE TESTS AND DETERMINE NEEDED REPAIRS

---

## PERFORMANCE OBJECTIVE:

Given an engine at normal operating temperatures, and using the proper test equipment, and service manual; perform a cylinder balance test under instructor supervision. Time limit is one hour. The reading must be within +/- 10 percent of the reading found by the instructor.

## PERFORMANCE ACTIONS:

3.1901 Connect cylinder balance tester to the engine following instructions with the machine.

3.1902 Adjust engine RPM to recommended speed.

3.1903 Using short-out switches on the balance tester, short out one cylinder at a time.

3.1904 Record the RPM's for each cylinder.

3.1905 If drop varies in RPM's between cylinder, then a problem may exist within the cylinder.

## PERFORMANCE STANDARDS:

- Perform a cylinder balance test within one hour on a simulated or actual performance test.
- Reading must agree with instructors +/- 10 percent.

SUGGESTED INSTRUCTION TIME: 1 Hour

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.20 DIAGNOSE VALVE TRAIN AND HEAD MALFUNCTIONS

---

PERFORMANCE OBJECTIVE:

Using the proper tools and equipment, examine the valve train and head of an operating engine and identify the malfunctions, under instructor's supervision. All malfunctions given by the instructor must be identified.

PERFORMANCE ACTIONS:

3.2001 Remove rocker arm cover(s).

3.2002 While engine is running, visually inspect valve stems, push rods and rocker arms for proper operation. (NOTE: Some engine cannot be checked while running.)

3.2003 Using a feeler gauge or dial indicator, check intake and exhaust valves for proper clearance and timing according to manufacturer's specifications.

3.2004 Remove spark plugs as per manufacturer's specifications.

3.2005 Check for weak compression as caused by weak, worn, or faulty piston rings.

PERFORMANCE STANDARDS:

- Examine valve train and head of an operating engine and identify the 100 percent of malfunctions found by instructor.
- Outline necessary repairs.

SUGGESTED INSTRUCTION TIME: 6 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.21 CLEAN ENGINE PARTS AND CHECK FOR CONDITION

---

PERFORMANCE OBJECTIVE:

With the engine disassembled, and using the proper cleaning equipment, clean and inspect each engine component for proper condition, under instructor supervision. All components needing maintenance and repair must be identified to the instructor, and each cleaned part must meet instructor's approval.

PERFORMANCE ACTIONS:

3.2101 Clean parts in parts cleaning tank, heads and manifolds. Scrape carbon from heads and manifolds and wire brush old gaskets and remove valves before submerging in cleaning tank.

3.2102 Check cleaned parts for wear, warpage and any other abnormal conditions existing.

3.2103 Consult manufacturer's service manual for wear specifications.

PERFORMANCE STANDARDS:

- Clean and inspect a given disassembled engine for proper condition of components identifying all components needing maintenance and repair.
- Findings must agree 100 percent with instructor's diagnosis.

SUGGESTED INSTRUCTION TIME: 6 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.22 PERFORM OPERATIONAL INSPECTIONS OF THE ENGINE LUBRICATION SYSTEMS

---

## PERFORMANCE OBJECTIVE:

Given an automobile, service manual, and access to the proper tools, and gauges; perform operational inspections of the engine lubrication systems following the manufacturer's recommended procedures. All malfunctions (stoppages) identified by the instructor must be recognized.

## PERFORMANCE ACTIONS:

3.2201 Refer to manufacturer's service information and specifications and procedures.

3.2202 Check oil pump for wear and operation, also check oil pump screen.

3.2203 Check filter mounting for defects and clogged passageways.

3.2204 Using air and suitable rods, check crankshaft and block for open and clean passages.

3.2205 Check oil passages in cylinder head leading to rocker arm area (where applicable) using air and suitable rods.

## PERFORMANCE STANDARDS:

- Perform operational inspections of engine lubrication systems following manufacturer's recommendations procedures.
- All malfunctions (stoppages) identified by the instructor must be recognized.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.23 REPLACE CAMSHAFT, REPLACE CAMSHAFT BEARINGS, REPLACE TIMING GEARS AND CHAINS, REPLACE GASKETS AND SEALS, REPLACE VALVE LIFTERS

---

PERFORMANCE OBJECTIVE:

Given an automobile engine and access to the proper tools, equipment, and service manual, remove and replace the camshaft in accordance with the manufacturer's specifications and procedures. Camshaft and related component parts will work freely without binding or leakage upon completion of the repairs.

PERFORMANCE ACTIONS:

3.2301 Remove front timing cover and fuel pump.

3.2302 Remove timing chain and gears.

3.2303 Remove push rods and rocker arm assembly.

3.2304 Remove valve lifters.

3.2305 Remove camshaft.

3.2306 Remove cam bearings and observe position of oil feed holes.

3.2307 Remove expansion plugs.

3.2308 Clean oil passages.

3.2309 Install cam bearings in respective position being careful to line up oil holes.

3.2310 Install camshaft, make sure cam turns freely.

3.2311 Install timing chain, sprockets, seals, gaskets, and timing cover.

3.2312 Install new lifters, push rods and rocker assembly.

PERFORMANCE STANDARDS:

- Remove and replace camshaft in accordance with manufacturer's specifications and procedures.

PERFORMANCE STANDARDS (Con't.):

- Camshaft and related component parts will work freely without binding or leakage upon completion of repairs.

SUGGESTED INSTRUCTION TIME: 18 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.24 REPAIR AND REPLACE INTAKE MANIFOLD AND GASKETS

---

PERFORMANCE OBJECTIVE:

Given an automobile engine, the student will remove and replace the intake manifold in accordance with manufacturer's specifications.

PERFORMANCE ACTIONS:

3.2401 Check gasket surfaces on head and manifold and be sure they are very clean.

3.2402 Lay gasket over intake ports and check size of gasket port holes and head ports. Most gaskets have a top and a bottom. Check to be sure it is right side up.

3.2403 Install intake manifold.

3.2404 Screw in manifold bolts with speed wrench and socket.

3.2405 Torque bolts to specifications starting with bolts in the center and work to bolts on both ends.

PERFORMANCE STANDARDS:

- Remove and replace intake manifold on a given vehicle according to manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 8 Hours

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|---|---|---|
| UNIT | 3.0 | AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL |
| TASK | 3.25 | ADJUST VALVES |

---

PERFORMANCE OBJECTIVE:

Given automobile engine with mechanical valve lifters, necessary tools, equipment, and service manual; adjust exhaust and intake valve "lash" according to manufacturer's specification and method. Any variations must be detected and corrected.

PERFORMANCE ACTIONS:

3.2501 Demonstrate adjustment procedures using flat feeler gauge of specific thickness for intake and exhaust valve lash. (Manufacturer's specifications.)

PERFORMANCE STANDARDS:

- Adjust exhaust and intake valve "lash" according to manufacturer's specifications and methods.
- Meet instructor's standards in detecting and correcting variations.

SUGGESTED INSTRUCTION TIME: 6 Hours

RELATED TECHNICAL INFORMATION:

- Explain "noise" made by mechanical valve lifters.
- Explain necessity for valve lash variations between intake and exhaust valves.

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.26 INSPECT, REPLACE AND/OR GRIND VALVE FACE AND STEM

---

PERFORMANCE OBJECTIVE:

Given a cylinder head, the student will grind the valve face and stem using valve machine in accordance with manufacturer's specifications.

PERFORMANCE ACTIONS:

3.2601 Clean valves and inspect for stem wear and warpage.

3.2602 Refinish valve face.

3.2603 Refinish stem end.

3.2604 Chamfer cut stem end.

PERFORMANCE STANDARDS:

- Grind valve face and stem, using machine according to manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.27 REFACING VALVE SEATS

---

PERFORMANCE OBJECTIVE:

Given an cylinder head, the student will reface the valve seats using a valve seat grinder and maintaining a concentricity of .002 inch.

PERFORMANCE ACTIONS:

3.2701 Clean out valve ports.

3.2702 Use valve guide cleaning tool and clean all valve guides and check for wear.

3.2703 From repair manual find the correct valve seat angle for this model car and size of engine.

3.2704 Select the correct size pilot for guide and check to make sure the fit is snug.

3.2705 Use a stone dressing tool and dress stone for proper seat angle.

3.2706 Use the grinding stone that has been dressed and grind proper angle on the valve seat.

3.2707 Inspect the valve seat to make sure that the stone has been held squarely to the valve seat and that the same dimension has been held around the entire circumference of the seat.

3.2708 If the seat is over 3/64" wide after grinding, use a 15 degree stone to narrow the face to proper dimension.

3.2709 Use a lapping tool and lapping compound to lap valves to reground seats.

PERFORMANCE STANDARDS:

- Reface valve seats using a valve seat grinder and maintaining concentricity of .002 inch.
- Meet instructor's standards and use grinder according to manufacturer's procedures.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.28 KNURL VALVE GUIDE

---

PERFORMANCE OBJECTIVE:

Given cylinder head(s) totally disassembled, and proper tools and equipment; students will be able to knurl valve guides to a correct fit.

PERFORMANCE ACTIONS:

3.2801 Using micrometer check reading of valve stem virgin and wear.

3.2802 Drill indent in valve guide on topside to receive knurling wheel.

3.2803 Select smallest knurling wheel and knurl valve guide.

3.2804 Select reamer .001 inch large than valve stem recorded above.

3.2805 Ream valve guide.

3.2806 Thoroughly clean valve guide and lubricate.

3.2807 Place valve in guide and check fit.
(NOTE: Valve stem and guide should create vacuum.)

PERFORMANCE STANDARDS:

- On a totally disassembled cylinder head, knurl valve guide to correct fit.
- Valve stem and guide should create a vacuum.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.29 REMOVE AND REPLACE OIL PUMP

---

PERFORMANCE OBJECTIVE:

Provided an engine, and given access to a service manual and proper hand tools; replace the oil pump following the manufacturer's recommended procedures. Operation of the oil pump after installation must meet the manufacturer's specifications and must have no leaks or other malfunctions.

PERFORMANCE ACTIONS:

3.2901 Raise vehicle and place on safety stands.

3.2902 Drain oil from oil pan.

3.2903 Remove oil pan, follow manufacturer's guide.

3.2904 Remove oil pump and examine to determine reason for failure before replacing with new pump.

3.2905 Replace new pump and reverse procedures.

PERFORMANCE STANDARDS:

- Remove and replace oil pump following manufacturer's recommended procedures.
- Operation of pump after installation must meet manufacturer's specifications and have no leaks or other malfunctions.

SUGGESTED INSTRUCTION TIME: 16 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.30 REPLACE FLYWHEEL AND FLYWHEEL RING GEAR

---

PERFORMANCE OBJECTIVE:

Provided a vehicle, service manual, and access to the proper tools and equipment; replace the flywheel ring gear and flywheel, following the manufacturer's specifications and procedures. When completed, the flywheel ring gear will function without noise or slippage.

PERFORMANCE ACTIONS:

3.3001 Raise vehicle and place on jack stands.

3.3002 Remove drive line.

3.3003 Remove transmission and bell housing.

3.3004 Remove clutch assembly.

3.3005 Scribe position of flywheel on crankshaft.

3.3006 Remove flywheel on crankshaft.

3.3007 Remove flywheel.

3.3008 Remove flywheel ring gear.

3.3009 Install new ring.

3.3010 Replace flywheel, lining up scribe marks.

3.3011 Reassemble following the reverse order.

PERFORMANCE STANDARDS:

- Replace flywheel ring gear and flywheel following manufacturer's procedures and specifications so that when completed flywheel ring gear functions without noise or slippage.

SUGGESTED INSTRUCTION TIME: 8 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.31 REMOVE AND REPLACE ENGINE FROM VEHICLE

---

## PERFORMANCE OBJECTIVE:

Given an automobile requiring engine removal, and access to a engine hoist, or chain hoist, service manual, hand tools, and other needed equipment; remove the engine from the vehicle following the manufacturer's recommended procedures. The engine must be removed without incurring any damage to surrounding items and equipment. All accepted safety practices must be observed.

## PERFORMANCE ACTIONS:

3.3101 Mark and remove hood.

3.3102 Disconnect and remove battery.

3.3103 Raise vehicle and properly set stands.

3.3104 Drain cooling system.

3.3105 Remove radiator, disconnect cooler lines where applicable.

3.3106 Disconnect engine supports and exhaust manifold(s).
- a. Where applicable, remove with transmission.
- b. Remove transmission oil coolers lines and linkage.
- c. Drain transmission.
- d. Disconnect drive line.

3.3107 Remove fan assembly.

3.3108 Disconnect fuel line and plug.

3.3109 Disconnect all electrical connections.

3.3110 Disconnect accelerator linkage.

3.3111 Attach chain, made certain all objects clear chain to avoid damage.

3.3112 Remove engine.

3.3113 Install in reverse order.

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|---|---|---|
| UNIT | 3.0 | AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL |
| TASK | 3.31 | REMOVE AND REPLACE ENGINE FROM VEHICLE (Con't.) |

PERFORMANCE STANDARDS:

- Remove and replace engine from vehicle following manufacturer's recommended procedures.
- The engine must be removed without incurring any damage to surrounding items and equipment.
- All accepted safety practices must be observed.

SUGGESTED INSTRUCTION TIME: 33 Hours

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.32 REMOVE AND REPLACE CONNECTING RODS AND BEARINGS, REMOVE AND REPLACE PISTONS AND RINGS, AND INSPECT PARTS WITH MICROMETERS AND PLASTIGAUGE

---

PERFORMANCE OBJECTIVE:

Using the proper hand tools and service manual, remove and replace the connecting rods and rod bearings in a given engine, according to manufacturer's specifications. Upon completion, there will be no leaks in the repaired area and the oil pressure and engine temperature will conform to the manufacturer's specifications.

PERFORMANCE ACTIONS:

3.3201 Remove cylinder head(s).

3.3202 Remove oil pan.

3.3203 Ridge ream cylinder.

3.3204 Check to see if rods are numbered by cylinder and mark if necessary.

3.3205 Remove rod nuts and caps.

3.3206 Install rod journal protectors on rod studs to protect crankshaft.

3.3207 Remove piston and rod assembly.

3.3208 Clean and inspect cylinder walls.

3.3209 Using inside micrometers or cylinder bore gauge, gauge cylinders for wear and taper.

3.3210 Using hone, deglaze cylinder.

3.3211 Measure crankshaft journals for wear, and out-of-round, (high and low readings).

3.3212 Remove piston rings.

3.3213 Clean ring grooms, inspect piston for wear, cracks, lands, and grooves for signs of wear.

3.3214 Check wrist pins for looseness and align rod and piston.

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.32 REMOVE AND REPLACE CONNECTING RODS AND BEARINGS, REMOVE AND REPLACE PISTONS AND RINGS, AND INSPECT PARTS WITH MICROMETERS AND PLASTIGAUGE (Con't.)

---

PERFORMANCE ACTIONS (Con't.):

3.3215 Check rings for proper ring gap.

3.3216 Install rings being cautious to install in proper grooves and proper side up.

3.3217 Lubricate rings generously and install ring compressor.

3.3218 Install bearings, inserts in rod and cap observing oil holes for alignment.

3.3219 Install connecting rod assembly in engine block. (NOTE: That piston notch or arrow is pointing toward front of engine.)

3.3220 Using plastigauge and feeler gauge methods, check for clearance. Remove plastigauge and lubricate.

3.3221 Retorque connecting rods.

3.3222 Rotate crank after each connecting rod has been installed. Crank should turn freely allowing for slight drag of new rings.

3.3223 Install oil pan.

3.3224 Install cylinder heads.

3.3225 Fill crankcase with correct grade and weight oil.

3.3226 Fill radiator with coolant.

3.3227 Start engine, checking oil pressure, engine temperature and examine for leaks.

PERFORMANCE STANDARDS:

- Remove and replace connecting rods and bearings on a given engine according to manufacturer's specifications.

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.32 REMOVE AND REPLACE CONNECTING RODS AND BEARINGS, REMOVE AND REPLACE PISTONS AND RINGS, AND INSPECT PARTS WITH MICROMETERS AND PLASTIGAUGE (Con't.)

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PERFORMANCE STANDARDS (Con't.):

- Upon completion, there will be no leaks in the repaired area and the oil pressure and engine temperature will conform to the manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 32 Hours

| | | |
|---|---|---|
| UNIT | 3.0 | AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL |
| TASK | 3.33 | REMOVE AND REPLACE CRANKSHAFT AND BEARINGS, INSPECT WITH MICROMETERS AND PLASTIGAUGE FOR PROPER BEARING FIT |

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PERFORMANCE OBJECTIVE:

Given an assigned crankshaft and block assembly, and using the proper tools, equipment, and service manual; replace the crankshaft and main bearings according to the manufacturer's procedures and specifications.

PERFORMANCE ACTIONS:

3.3301 Remove oil pan.

3.3302 Remove oil pump and screen.

3.3303 Check for main bearing and rod bearing markings and arrows on main bearing caps. Mark if necessary.

3.3304 Remove main and rod bearing caps.

3.3305 Remove crankshaft.

3.3306 Measure the crankshaft and record the readings.

3.3307 Inspect the bearing saddles in the block to determine that all galleries are clean and blown free of dirt.

3.3308 Inspect new bearings and make certain size is correct for the replacement.

3.3309 Install upper bearings in proper place.

3.3310 Lubricate top half of bearings with engine oil or other appropriate lubricant.

3.3311 Install the rear main bearing seal.

3.3312 Put crankshaft in place (be certain crankshaft is clean and all oil holes have been blown out).

3.3313 Rotate crankshaft back and forth to make certain no binding occurs.

UNIT 3.0 AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

TASK 3.33 REMOVE AND REPLACE CRANKSHAFT AND BEARINGS, INSPECT WITH MICROMETERS AND PLASTIGAUGE FOR PROPER BEARING FIT (Con't.)

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PERFORMANCE ACTIONS (Con't.):

3.3314 Install bearings in lower caps.

3.3315 Install bearings in engine block. Measure with plastigauge to meet proper specification. Remove plastigauge and lubricate bearings.

3.3316 Tighten connecting rod caps to torque specifications in sequential order.

3.3317 Turn crankshaft after each bearing has been torqued to insure proper functioning.
(CAUTION: Do not turn the crankshaft with plastigauge installed.)

3.3318 Check connecting rod side clearance and crankshaft end play.

PERFORMANCE STANDARDS:

- Remove and replace crankshaft and bearings according to manufacturer's specifications and procedures.

SUGGESTED INSTRUCTION TIME: 31 Hours

## TASK LISTINGS
## AUTOMOTIVE MECHANICS

| UNIT/TASK | DESCRIPTION |
|---|---|
| Unit 4.0 | FUEL SYSTEM MAINTENANCE AND REPAIR |
| 4.01 | (Replace a Fuel Filter) Given a car with a fuel filter in need of replacement, remove and replace the fuel filter in accordance with the manufacturer's specifications. |
| 4.02 | (Repairs or Services Carburetors) Given an automobile with a malfunctioning carburetor, a service manual, and access to the proper tools and equipment; diagnose the problem and service or repair the malfunction under the supervision of the instructor. Repairs must conform to manufacturer's specifications. |
| 4.03 | (Adjust Carburetor) Provided a vehicle and the necessary tools and equipment, adjust the carburetor to manufacturer's specifications by following the recommended procedure. Idle set must be within +/- 50 RPM's of the manufacturer's specifications. |
| 4.04 | (Inspects, Cleans, and Adjusts Choke Unit /Automatic and Manual/) Given a vehicle and the proper hand tools, equipment, and service manual; inspect, clean and adjust the automatic choke unit, checking instructor's supervision. Adjust must meet the manufacturer's tolerances. |
| 4.05 | (Install Carburetor) Using the proper hand tools, equipment, and service manual; replace the carburetor on a given vehicle, following the recommended replacement procedures. Idle speed must be within +/- 50 RPM's of manufacturer's specifications. |
| 4.06 | (Removes, Services, or Replaces Fuel Lines and Hoses) Using the proper hand tools, equipment, and service manual; remove and replace the fuel line on a given vehicle following the manufacturer's recommended procedures. Operation, after installment, must conform to the manufacturer's specifications. |
| 4.07 | (Inspect and Measures Fuel Flow and Pressure of System) Provided an operational vehicle and access to the proper hand tools, equipment, and service manual; measure the pressure and flow of fuel in the pump, under the instructor's supervision. The measurement found by the instructor must be attained by the student. |
| 4.08 | (Replace Fuel Pump) Given a car with a fuel pump needing replacement, remove and replace the fuel pump in accordance with manufacturer's specifications. |

4.09 (Adjust Fuel Injection System) Given a vehicle, service manual, and necessary tools and equipment; adjust the fuel injection system by means of electronic diagnostic equipment.

4.10 (Inspects, Services, or Replaces Fuel Sending Unit) Given a vehicle with a faulty fuel level sending unit, and access to proper hand tools, equipment, and service manual; replace the fuel tank sending unit, following the manufacturer's recommended procedures. After installation, the dash indicator must register as prescribed in the manufacturer's service manual.

4.11 (Analyze for Moisture or Foreign Particles in Fuel Tank) Given a vehicle with apparent moisture of foreign particles in the fuel tank or lines, the vehicle service manual and necessary tools and equipment, remove the fuel tank and clean moisture and dirt from the tank, as recommended by the manufacturer's instructions. The tank must be free of dirt and moisture.

4.12 (Diagnose and Repair Fuel System Malfunctions) Given a vehicle and the ncessary tools and equipment, remove the carburetor bowl cover and inspect the carburetor for dirt sediment and moisture; if foreign particles exist, clean the carburetor as recommended by the manufacturer's specifications.

4.13 (Rebuild Carburetors) Given an automobile, service manual, necessary tools and replacement parts; rebuild carburetor. When completed the carburetor should have all screws, clamps, and hoses secure. The carburetor should operate and be adjusted within manufacturer's specifications. There should be no leaks.

UNIT 4.0 FUEL SYSTEM MAINTENANCE AND REPAIR

TASK 4.01 REPLACE A FUEL FILTER

---

## PERFORMANCE OBJECTIVE:

Given a car with a fuel filter in need of replacement, remove and replace the fuel filter in accordance with the manufacturer's specifications.

## PERFORMANCE ACTIONS:

4.0101 Prepare for replacing a fuel filter.

4.0102 Place container under fuel filter.

4.0103 Remove filter clamps.

4.0104 Remove filter.

4.0105 Replace filter by placing clamps loosely on fuel lines.

4.0106 Position filter correctly in place and slip on lines.
(NOTE: Note direction, if applicable.)

4.0107 Tighten clamps.

4.0108 Start engine and check for leaks.

4.0109 Remove container, tools, and fender covers.

## PERFORMANCE STANDARDS:

- Remove and replace fuel filter on a given automobile.

SUGGESTED INSTRUCTION TIME: 2 Hours

## RELATED TECHNICAL INFORMATION:

- Manufacturer's specifications.
- Note correct direction of filter, if applicable.

UNIT 4.0 FUEL SYSTEM MAINTENANCE AND REPAIR - LEVEL II

TASK 4.02 REPAIRS OR SERVICES CARBURETORS

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PERFORMANCE OBJECTIVE:

Given an automobile with a malfunctioning carburetor, a service manual, and access to the proper tools and equipment, diagnose the problem and service or repair the malfunction under the supervision of the instructor. Repairs must conform to manufacturer's operating specifications.

PERFORMANCE ACTIONS:

4.0201 Road test or start vehicle as needed.

4.0202 Diagnose and report malfunction.

4.0203 Take necessary steps to repair malfunction.

4.0204 Check for leaks and operation.

4.0205 Test drive vehicle.

PERFORMANCE STANDARDS:

- On an instructor provided automobile with a malfunctioning carburetor, locate the problem and repair the carburetor.

SUGGESTED INSTRUCTION TIME: 12 Hours

UNIT 4.0 FUEL SYSTEM MAINTENANCE AND REPAIR - LEVEL II

TASK 4.03 ADJUST CARBURETOR

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## PERFORMANCE OBJECTIVE:

Provided a vehicle and the necessary tools and equipment, adjust the carburetor to manufacturer's specifications by following the recommeded procedure. Idle set must be within +/- 50 RPM's of the manufacturer's specifications.

## PERFORMANCE ACTIONS:

4.0301 Connect tachometer to automobile.

4.0302 Adjust idle mixture screws (following manufacturer's specifications).

4.0303 Adjust curb idle adjustment screw (according to manufacturer's specifications).

4.0304 Remove tachometer.

4.0305 Test drive vehicle.

## PERFORMANCE STANDARDS:

- Adjust fuel mixture and idle set adjustments on a vehicle provided by the instructor. Idle set must be within 50 +/- RPM's of the manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 4.0 FUEL SYSTEM MAINTENANCE AND REPAIR - LEVEL II

TASK 4.04 INSPECTS, CLEANS, AND ADJUSTS CHOKE UNIT (AUTOMATIC AND MANUAL)

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## PERFORMANCE OBJECTIVE:

Given a vehicle and the proper hand tools, equipment, and service manual; inspect, clean and adjust the automatic choke unit, checking instructor's supervision. Adjust must meet the manufacturer's tolerances.

## PERFORMANCE ACTIONS:

4.0401 Remove carburetor air cleaner.

4.0402 Disassemble automatic choke; clean screen and unit, as appropriate.

4.0403 Check sticking of piston and freeness of linkage.

4.0404 Reassemble automatic choke.

4.0405 Adjust choke to recommended setting.

## PERFORMANCE STANDARDS:

- On an instructor provided automobile with a choke needing service, inspect, clean and adjust the automatic choke to manufacturer's tolerances.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 4.0 FUEL SYSTEM MAINTENANCE AND REPAIR - LEVEL II

TASK 4.05 INSTALL CARBURETOR

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## PERFORMANCE OBJECTIVE:

Using the proper hand tools, equipment, and service manual; replace the carburetor on a given vehicle following the recommended replacement procedures. Idle speed must be within +/- 50 RPM's of manufacturer's specifications.

## PERFORMANCE ACTIONS:

4.0501 Remove carburetor air cleaner.

4.0502 Disconnect accelerator linkage, fuel line, automatic choke, and vacuum lines where required.

4.0503 Remove carburetor.

4.0504 Install carburetor, following procedures in reverse.

4.0505 Complete final carburetor servicing as required.

## PERFORMANCE STANDARDS:

- Install a carburetor and set the idle speed in the automobile provided by the instructor.

SUGGESTED INSTRUCTION TIME: 3 Hours

UNIT 4.0 FUEL SYSTEM MAINTENANCE AND REPAIR - LEVEL II

TASK 4.06 REMOVES, SERVICES, OR REPLACES FUEL LINES AND HOSES

---

PERFORMANCE OBJECTIVE:

Using the proper hand tools, equipment, and service manual; remove and replace the fuel line on a given vehicle following the manufacturer's recommended procedures. Operation, after installment, must conform to the manufacturer's specifications.

PERFORMANCE ACTIONS:

4.0601 Check fuel lines from carburetor to gas tank.

4.0602 Disconnect fuel lines as needed.

4.0603 Install new fuel lines.

4.0604 Tighten fuel line connection.

4.0605 Start vehicle and check for fuel leaks.

4.0606 Test drive vehicle.

PERFORMANCE STANDARDS:

- On an automobile with a faulty fuel line, remove the faulty fuel line and replace it with a new one.

SUGGESTED INSTRUCTION TIME: 4 Hours

| | | |
|---|---|---|
| UNIT | 4.0 | FUEL SYSTEM MAINTENANCE AND REPAIR - LEVEL II |
| TASK | 4.07 | INSPECT AND MEASURES FUEL FLOW AND PRESSURE OF SYSTEM |

---

PERFORMANCE OBJECTIVE:

Provided an operational vehicle and access to the proper hand tools, equipment, and service manual; measure the pressure and flow of fuel in the pump, under the instructor's supervision. The measurement found by the instructor must be attained by the student.

PERFORMANCE ACTIONS:

4.0701 Remove air cleaner assembly.

4.0702 Disconnect fuel line at the carburetor.

4.0703 Connect fuel pressure and flow gauge to fuel line in accordance with manufacturer's specifications.

4.0704 Either crank with starter or run vehicle the required time for proper fuel check.

4.0705 Compare reading with proper vehicle specifications.

PERFORMANCE STANDARDS:

- On an instructor provided vehicle with the engine running, measure the pressure and flow of fuel in the fuel pump.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 4.0 FUEL SYSTEM MAINTENANCE AND REPAIR - LEVEL II

TASK 4.08 REPLACE FUEL PUMP

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## PERFORMANCE OBJECTIVE:

Given a car with a fuel pump needing replacement, remove and replace the fuel pump in accordance with manufacturer's specifications.

## PERFORMANCE ACTIONS:

4.0801 If applicable, remove pump heat shield.

4.0802 Disconnect fuel lines. Use proper techniques to prevent damage to line fittings.

4.0803 Remove nut or cap screws holding pump to block.

4.0804 Remove fuel pump. If pump is activated by a push rod, remove rod and measure it against manufacturer's specifications. Replace rod if it is shorter than recommended.

4.0805 Clean block surface and fuel pump.

4.0806 Cement gasket in place and install pump.
(NOTE: If pump will not fit flat against block,
rotate engine until cam eccentric is down.)

4.0807 Tighten cap screws or bolts evenly.

4.0808 Reinstall fuel line fittings with fingers hand tight.

4.0809 Tighten all fittings with flare-nut wrench.

4.0810 Start engine and check for leaks.

## PERFORMANCE STANDARDS:

- Replace fuel pump on automobile with faulty pump. Replacement and all adjustments should meet manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 4 Hours

## ADDITIONAL TECHNICAL INFORMATION:

- Electric fuel pumps mounted in tank may require removal of fuel tank.

UNIT 4.0 FUEL SYSTEM MAINTENANCE AND REPAIR - LEVEL II

TASK 4.09 ADJUST FUEL INJECTION SYSTEM

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PERFORMANCE OBJECTIVE:

Given a vehicle, service manual, and necessary tools and equipment, adjust the fuel injection system by means of electronic diagnostic equipment.

PERFORMANCE ACTIONS:

4.0901 Adjust air induction door.

4.0902 Adjust choke.

4.0903 Adjust idle speed and mixture.

4.0904 Adjust injection.

4.0905 Adjust cold start switches.

4.0906 Adjust injection timing.

PERFORMANCE STANDARDS:

- Adjust fuel injection system using electrical diagnostic equipment.

SUGGESTED INSTRUCTION TIME: *

(NOTE: "Actions" may be used as a "checklist" of performance.)

*Currently, electronic diagnostic equipment to test fuel injection systems is not on hand at secondary level centers.

| | | |
|---|---|---|
| UNIT | 4.0 | FUEL SYSTEM MAINTENANCE AND REPAIR - LEVEL II |
| TASK | 4.10 | INSPECTS, SERVICES, OR REPLACES FUEL SENDING UNIT |

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PERFORMANCE OBJECTIVE:

Given a vehicle with a faulty fuel level sending unit, and access to proper hand tools, equipment, and service manual; replace the fuel tank sending unit, following the manufacturer's recommended procedures. After installation, the dash indicator must register as prescribed in the manufacturer's service manual.

PERFORMANCE ACTIONS:

4.1001 Place vehicle on suitable hoist or service stands.

4.1002 Disconnect fuel lines and sending unit wire.

4.1003 Remove fuel tank.

4.1004 With air or brush, clean off all dirt, and particles that may fall into fuel tank.

4.1005 Remove sending unit.

4.1006 Install new sending unit.

4.1007 Connect ground wire between tank and frame of vehicle.

4.1008 Connect sending unit wire.

4.1009 Check dash unit for proper operation.

4.1010 Reinstall fuel tank.

4.1011 Lower vehicle.

PERFORMANCE STANDARDS:

- Replace the fuel tank sending unit on the automobile provided by the instructor.

SUGGESTED INSTRUCTION TIME: 4 Hours

| | | |
|---|---|---|
| UNIT | 4.0 | FUEL SYSTEM MAINTENANCE AND REPAIR - Level II |
| TASK | 4.11 | ANALYZE FOR MOISTURE OR FOREIGN PARTICLES IN FUEL TANK |

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## PERFORMANCE OBJECTIVE:

Given a vehicle with apparent moisture or foreign particles in the fuel tank or lines, the vehicle service manual and necessary tools and equipment; remove the fuel tank and clean moisture and dirt from the tank, as recommended by the manufacturer's instructions. The tank must be free of dirt and moisture.

## PERFORMANCE ACTIONS:

4.1101 Raise vehicle on suitable hoist or safety stands.

4.1102 Disconnect fuel line and sending unit wire.

4.1103 Remove fuel tank.

4.1104 Remove sending unit and drain plug (if equipped).

4.1105 Drain fuel tank and flush tank with water and air.

4.1106 Rinse with alcohol to remove any remaining moisture in fuel tank.

4.1107 Install sending unit and drain plug.

4.1108 Install fuel tank.

4.1109 Connect fuel line and sending unit wire.

4.1110 Check for leaks and sending unit operation.

## PERFORMANCE STANDARDS:

- On an instructor provided automobile with moisture or dirt in the gas tank, remove the tank and clean it of the foreign matter.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 4.0 FUEL SYSTEM MAINTENANCE AND REPAIR - LEVEL III

TASK 4.12 DIAGNOSE AND REPAIR FUEL SYSTEM MALFUNCTIONS

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PERFORMANCE OBJECTIVE:

Given a vehicle and the necessary tools and equipment, remove carburetor bowl cover inspect the carburetor for dirt sediment and moisture; if foreign particles exist, clean the mounted carburetor.

PERFORMANCE ACTIONS:

4.1201 Remove air cleaner assembly.

4.1202 Remove carburetor bowl cover if checking or adjusting.

4.1203 If dirt and moisture is found, see sources and correct. See Task 4.13.

4.1204 Clean carburetor.

4.1205 Check float valve level and needle seat.

4.1206 Reassemble.

4.1207 Start vehicle and adjust mixture screws and curb idle screw (to manufacturer's specifications).

4.1208 Test vehicle performance if appropriate.

PERFORMANCE STANDARDS:

- On an automobile showing evidence of dirt or moisture in the carburetor, inspect the carburetor and clean all dirt and moisture from the mounted unit.

SUGGESTED INSTRUCTION TIME: 3 Hours

(NOTE: Some carburetor models may require different actions or removal of carburetor for inspection and service.)

UNIT 4.0 FUEL SYSTEM MAINTENANCE AND REPAIR - LEVEL III

TASK 4.13 REBUILD CARBURETOR

---

PERFORMANCE OBJECTIVE:

Given an automobile, service manual, necessary tools and replacement parts; rebuild carburetor. When completed the carburetor should have all screws, clamps, and hoses secure. The carburetor should operate and be adjusted within manufacturer's specifications. There should be no leaks.

PERFORMANCE ACTIONS:

4.1301 Observe safety precautions in using carburetor cleaner.

4.1302 Disassemble carburetor according to manufacturer's specifications.

4.1303 Test and set assembly parts as appropriate.

4.1304 Clean and air blow dry appropriate parts.

4.1305 Reassemble carburetor.

4.1306 Adjust to manufacturer's specifications.

PERFORMANCE STANDARDS:

- Rebuild a given carburetor making the necessary repairs and adjustments and reinstall the carburetor on the vehicle and adjust it to manufacturer's specifications. The carburetor should operate and be adjusted within specifications and should show no leaks.

SUGGESTED INSTRUCTION TIME: 12 Hours*

*Time depends on type of carburetor.

# TASK LISTINGS
# AUTOMOTIVE MECHANICS

| UNIT/TASK | DESCRIPTION |
|---|---|
| Unit 5.0 | EMISSION CONTROLS AND EXHAUST SYSTEM |
| 5.01 | (Service PCV System) On a given automobile check and routinely service the PCV system (PCV, orifice/metering, or diaphragm-valve/gulp or Smith Valve systems.) |
| 5.02 | (Inspect Exhaust System for Leaks or Damage) On a given automobile, with necessary tools and equipment, including a lift or jack; inspect the exhaust system for leaks or damage. |
| 5.03 | (Test and Adjust Idle Solenoid) Given an automobile, service manual, and necessary tools and equipment; test and adjust idle solenoid. |
| 5.04 | (Check and Service Fuel Evaporation System [Fuel-Vapor System]) Given a vehicle, service manual and necessary tools; check and service the fuel evaporation system. |
| 5.05 | (Service, Repair, or Replace Thermostatic Air Cleaner) Given a vehicle, service manual and necessary tools; service the thermostatic air cleaner (TAC) system. |
| 5.06 | (Test Air Injector Reactor System) Given a vehicle, service manual exhaust gas analyzer and necessary tools; test the AIR system. |
| 5.07 | (Test and Service Exhaust Gas Recirculation Valve Operation) Given a vehicle, service manual, vacuum pump and necessary tools and test equipment; test and service the EGR valve and component operation. |
| 5.08 | (Inspect and Service Manifold Heat Control Valve) On a given automobile with a manifold heat control valve requiring servicing, the proper tools, equipment, and supplies, and appropriate shop manual; inspect and service a manifold heat control valve. |
| 5.09 | (Remove and Replace Catalytic Converter) On a given vehicle, necessary tools, service manual, and replacement parts; remove and replace the catalytic converter. |
| 5.10 | (Inspect, Removes, and Replaces Tail Pipe or Muffler) On a given automobile using the necessary tools, equipment, replacement parts, supplies, and shop manual; inspect, remove and replace the tail pipe or muffler. |

UNIT 5.0 EMISSION CONTROLS AND EXHAUST SYSTEM - LEVEL I

TASK 5.01 SERVICE PCV SYSTEM

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## PERFORMANCE OBJECTIVE:

On a given automobile, check and routinely service the PCV system, (PCV, orifice/metering, or diaphragm-valve/gulp or Smith Valve systems).

## PERFORMANCE ACTIONS:

5.0101 Check hoses for damage. Make sure hoses are not clogged. (Clean with patch, etc., if dirty.)

5.0102 Make sure air cleaner, oil filter, etc., are clean.

5.0103 Check manfacturer's recommendation for PCV system service.
(NOTE: Check gulp valve diaphragm and spring on MG, Fiat, BMW, and other automobiles equipped with the diaphragm-valve system. Check blowby intake manifold fitting on Volvo and sealed crankcase-emission control system hoses on Subaru.

5.0104 Replace PCV valve after 12,000 miles of use or test PCV valve by pulling from engine and with engine running check vacuum (pull) by placing finger over valve opening.

5.0105 Check PCV air-filter element in the air-cleaner cover (not in every automobile). If dirty, replace it.

5.0106 On vehicles with a metering orifice, clean the openings.

## PERFORMANCE STANDARDS:

- Conduct general inspection and service of PCV system including filters, hoses, PCV valve, and other parts which are easily checked and which affect the PCV system.
- Inspection must be in accordance to standards established by the instructor and the vehicle manufacturer's service manual.

SUGGESTED INSTRUCTION TIME: 3 Hours

RELATED TECHNICAL INFORMATION:

- Emission Control Systems.
- PCV valve operation.

UNIT 5.0 EMISSION CONTROLS AND EXHAUST SYSTEM - LEVEL I

TASK 5.02 INSPECT EXHAUST SYSTEM FOR LEAKS OR DAMAGE

---

PERFORMANCE OBJECTIVE:

On a given automobile, with necessary tools and equipment, including a lift or jack; inspect the exhaust system for leaks or damage.

PERFORMANCE ACTIONS:

5.0201 Look for some form of damage, such as a hole or split seam, in the muffler.

5.0202 Tap the muffler with a wrench or other tool (may be combined with above step) to test if the muffler has a ring (good) or thud (bad) sound. At this time the surface of the muffler can be checked for weak spots that may have developed from inside.

5.0203 Check exhaust pipe flange-to-exhaust manifold connection (from inside engine compartment usually). Look for white residue at joint indicating gasket seal is bad. Also, listen for noise (popping) at this joint.
(NOTE: If bolts are tight at the joint, replace the gasket seal.)

5.0204 Inspect the exhaust system from the engine end to the tail pipe, checking connectors, resonators, etc. Look for holes or cracks.

5.0205 Check for a restriction such as a bend in a pipe or a stuck manifold heat control valve (in closed position).
(NOTE: Test using vacuum gauge at intake manifold.)

PERFORMANCE STANDARDS:

- Check a given automobile exhaust system for leaks or damage.
- Inspection must be in accordance with manufacturer's shop manual and instructor's standards.

SUGGESTED INSTRUCTION TIME: 4 Hours

| | | |
|---|---|---|
| UNIT | 5.0 | EMISSION CONTROLS AND EXHAUST SYSTEM - LEVEL II |
| TASK | 5.03 | TEST AND ADJUST IDLE SOLENOID |

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PERFORMANCE OBJECTIVE:

Given an automobile, service manual, and necessary tools and equipment; test and adjust idle solenoid.

(NOTE: This task overlaps the area of carburetor adjustment and engine tune-up.)

PERFORMANCE ACTIONS:

5.0301 Check to see that the idle stop solenoid energizes when the ignition is turned on. The solenoid de-energize when the ignition is turned off.

5.0302 If the solenoid does not operate,* check the electrical circuit. (Check solenoid with A/C on, if appropriate.)

5.0303 If there is proper electrical power to the solenoid, replace the defective solenoid. If there is no electrical power, check for the electrical fault in the system.

PERFORMANCE STANDARDS:

- Test and adjust idle solenoid on a given vehicle.
- When completed the solenoid operation will be in specifications, secure on its mount, and wire connected securely.

SUGGESTED INSTRUCTION TIME: 2 Hours

(*NOTE: On some late model cars, switch will only activate when air conditioner is on (1977 and later GM's.)

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UNIT 5.0 EMISSION CONTROLS AND EXHAUST SYSTEM - LEVEL II

TASK 5.04 CHECK AND SERVICE FUEL EVAPORATION SYSTEM (FUEL-VAPOR SYSTEM)

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PERFORMANCE OBJECTIVE:

Given a vehicle, service manual and necessary tools; check and service the fuel evaporation system.

PERFORMANCE ACTIONS:

5.0401 As necessary, following manufacturer's service manual, replace the evaporative control (fuel-vapor) system filter.

5.0402 Visually inspect system and check for strong odor of fuel.
(NOTE: For more sophisticated servicing, the infrared exhaust analyzer may be used to detect small vapor losses from around the fuel tank, air cleaner lines, or hoses. [Using HC meter])

5.0403 During visual inspection, check for damaged lines, liquid-fuel and vapor leaks, and missing parts. Inspect the filler cap for damage or corrosion that might cause the valves to fail to properly work. (Cap must meet manufacturer's specifications and completely seal fuel tank.)

5.0404 Replace items as necessary. (All replacement hoses must be suitable for use in evaporative control systems, resistant to deterioration from contact with gasoline and gasoline vapor.)

5.0405 Change cannister filter by removing bottom cover, pulling out old filter, and inserting new one. If cannister is cracked or internally plugges, replace the entire cannister.

PERFORMANCE STANDARDS:

- Check and service the fuel evaporation system. Upon completion, the lines will be check for length, security, and proper routing. Check the fuel evaporation system.
- There must be no fuel or vapor leaks in the system and the system must meet manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 5.0 EMISSION CONTROLS AND EXHAUST SYSTEM - LEVEL II

TASK 5.05 SERVICE, REPAIR, OR REPLACE THERMOSTATIC AIR CLEANER

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PERFORMANCE OBJECTIVE:

Given a vehicle, service manual, and necessary tools; service the thermostatic air cleaner (TAC) system.

PERFORMANCE ACTIONS:

5.0501 Inspect the TAC system hoses to be sure there are no leaks, kinks, etc., in the lines.

5.0502 Check and lubricate the manifold heat control valve as necessary (seen heat control valve).

5.0503 Tape a proper thermometer next to the TAC sensor. Following manufacturer's specifications, make certain that the valve "starts to open" and "full open" position fall at the correct temperatures.

5.0504 If damper does not work at correct temperatures, check vacuum motor and sensor. Replace faulty vacuum motor.

5.0505 Replace faulty sensor as necessary.

PERFORMANCE STANDARDS:

- Service the thermostatic air cleaner on a given automobile. When completed all hoses should be connected correctly, hot air pipe should be installed, and operation should have been checked.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 5.0 EMISSION CONTROLS AND EXHAUST SYSTEM - LEVEL II

TASK 5.06 (Optional) TEST AIR INJECTION REACTOR SYSTEM

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PERFORMANCE OBJECTIVE:

Given a vehicle, service manual exhaust gas analyzer and necessary tools; test the AIR system.

PERFORMANCE ACTIONS:

5.0601 Check for noise, no air supply, backfire, and high HC and CO levels in the exhaust as problems related to the AIR system.

5.0602 Check for the following possible causes of noise problems:
- Loose belt
- Loose air-pump mounting bolts
- Worn bearings or internal troubles
- Air leaks from the system

5.0603 Replace a pump that cannot be repaired, adjusted, or cleaned.

5.0604 Stop air leaks by tightening hose connections or replacing defective hoses.

5.0605 If no air is reaching manifold, exhaust gases will be high in HC and CO. Check for loose belt, frozen pump, leaks, and failed diverter or check valve. Replace non repairable items.

5.0606 If backfire is experienced, check for disconnected or blocked vacuum hoses. If the vacuum hose is in good condition, replace the defective diverter valve.

PERFORMANCE STANDARDS:

- Test Air Injection Reactor (AIR) system and repair or replace components as necessary so the AIR system is functioning properly.
  (NOTE: Do not overtighten the AIR pump.)
- Components may include:
  - Air pump
  - Belt
  - Diverter valve
  - Manifold/Distributor lines
  - Check valve
- When completed, check alignment, bolt security, leakage, and hose and line routing.

UNIT 5.0 EMISSION CONTROLS AND EXHAUST SYSTEM - LEVEL II

TASK 5.06 (Optional) TEST AIR INJECTION REACTOR SYSTEM (Con't.)

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SUGGESTED INSTRUCTION TIME: 4 Hours

RELATED TECHNICAL INFORMATION:

- Proper exhaust gas analyzer test connections.

UNIT 5.0 EMISSION CONTROLS AND EXHAUST SYSTEM - LEVEL II

TASK 5.07 TEST AND SERVICE EXHAUST GAS RECIRCULATION VALVE OPERATION

---

PERFORMANCE OBJECTIVE:

Given a vehicle, service manual, vacuum pump and necessary tools and test equipment; test and service the EGR valve and component operation.

PERFORMANCE ACTIONS:

5.0701 Check EGR valve by inspecting stem visible under diaphragm. The EGR stem should move up when the valve opens. If the stem does not move or is not visible, use a vacuum tester to check the EGR valve.

5.0702 With a vacuum tested connected, apply 8 inches Hg with the engine warm and in idle. If the valve does not operate, replace it.
- Test the thermal vacuum switch with a vacuum gauge and vacuum tester. No vacuum should pass through the switch with the engine cold. When the engine is warm, vacuum should pass through the switch.

PERFORMANCE STANDARDS:

- Test and service the EGR valve operation and component operation on a given automobile.
- When completed, check hose routing and length.
- Check that the gasket is secure and positioned correctly.
- The EGR valve must open completely when vacuum is applied and released.

SUGGESTED INSTRUCTION TIME: 5 Hours*

*Depends on vehicle make.

RELATED TECHNICAL INFORMATION:

- Test of EGR valve.

UNIT 5.0 EMISSION CONTROLS AND EXHAUST SYSTEM - LEVEL II

TASK 5.08 INSPECT AND SERVICE MANIFOLD HEAT CONTROL VALVE

---

PERFORMANCE OBJECTIVE:

On a given automobile with a manifold heat control valve requiring servicing, the proper tools, equipment, and supplies, and appropriate shop manual; inspect and service a manifold heat control valve.

PERFORMANCE ACTIONS:

5.0801 Determine if exhaust system is restricted by checking vacuum at intake manifold with vacuum gauge.

5.0802 If gauge's needle indicates a possible restriction, check the exhaust pipe for restriction or [illegible] first.

5.0803 Test manifold heat control valve. Tap it with a hammer and lubricate with manifold heat control lubricant if stuck.
(CAUTION: Don't use oil which can cause the valves to stick.)

PERFORMANCE STANDARDS:

- Inspect and service manifold heat control valve on a given automobile to manufacturer's specifications and instructor's standards.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 5.0 EMISSION CONTROLS AND EXHAUST SYSTEM - LEVEL II

TASK 5.09 REMOVE AND REPLACE CATALYTIC CONVERTER

---

PERFORMANCE OBJECTIVE:

On a given vehicle, necessary tools, service manual, and replacement parts; remove and replace the catalytic converter.

PERFORMANCE ACTIONS:

5.0901 Inspect catalytic converter for operation.

5.0902 To replace catalytic converter, follow manufacturer's shop manual instructions.

(NOTE: Some catalytic converters may be drained and the pellets replaced instead of replacing the catalytic converter.)

Given a vehicle catalytic converter requiring replacement pellets and necessary equipment; replace catalytic converter pellets. When completed, all old pellets must be removed and the proper amount of new pellets installed and the filler plug tightly replaced.)

PERFORMANCE STANDARDS:

- Remove and replace the catalytic converter on a given automobile. (Or, drain and replace converter pellets.)

SUGGESTED INSTRUCTION TIME: 3 Hours

RELATED TECHNICAL INFORMATION:

- Inspect system for exhaust leaks.
- Use of exhaust gas analyzer.
- Safety in working with catalytic converters.

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|---|---|---|
| UNIT | 5.0 | EMISSION CONTROLS AND EXHAUST SYSTEM - LEVEL II |
| TASK | 5.10 | INSPECTS, REMOVES, AND REPLACES TAIL PIPE OR MUFFLER |

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PERFORMANCE OBJECTIVE:

On a given automobile using the necessary tools, equipment, replacement parts, supplies, and shop manual; inspect, remove and replace the tail pipe or muffler.

PERFORMANCE ACTIONS:

5.1001 Inspect the exhaust system following previously outlined steps.

5.1002 Determine the replacement parts needed.

5.1003 Allow exhaust system to cool.

5.1004 Remove damaged exhaust system parts. Use penetrating oil, heat, or air chisel to remove frozen bolts.

5.1005 Install new system in place and clamp and bolt them securely so there are no leaks and so the system operates properly.

PERFORMANCE STANDARDS:

- Inspect, remove, and replace a tail pipe or muffler on a given automobile so that the repaired exhaust system is free of leaks, is not restricted, does not interfer with other systems of the vehicle and operates properly.

SUGGESTED INSTRUCTION TIME: 4 Hours

# TASK LISTINGS
## AUTOMOTIVE MECHANICS

| UNIT/TASK | DESCRIPTION |
|---|---|
| UNIT 6.0 A | COOLING SYSTEM MAINTENANCE AND REPAIR |
| 6.01 | (Check and Correct Coolant Level) Given a vehicle and necessary supplies, check and correct the radiator coolant level to manufacturer's specifications. |
| 6.02 | (Inspect, Adjust, or Replace Fan Belts) Given an automobile, and access to the appropriate service manual, tools, and equipment; inspect, adjust, or remove and replace the fan belt in accordance with the manufacturer's specifications. |
| 6.03 | (Check and Test Radiator Cap) Given an automobile, determine if the radiator pressure cap meets manufacturer's specifications by testing the cap with a radiator pressure tester. |
| 6.04 | (Test the Cooling System Thermostat) Using a thermostat tester or other appropriate method or equipment, test the thermostat for proper operation as designated by the manufacturer's specifications. Readings must be within 5 degrees F of the instructor's readings. |
| 6.05 | (Pressure Test Cooling System) Given a liquid cooled engine, test the cooling system including the radiator cap, with a pressure tester. |
| 6.06 | (Inspect and Replace Water Hoses) Using the appropriate hand tools, inspect and replace the upper and lower radiator hoses on an assigned operational engine, in accordance with the manufacturer's service procedures. |
| 6.07 | (Check Coolant Freezing Point) Using an antifreeze tester on a liquid cooled engine at operating temperature, record the freezing point of the cooling solution within 5 degrees F of the instructor's reading. |
| 6.08 | (Check Overflow Tank) On a given automobile equipped with an overflow tank, check the tank for proper operation and mounting as described in the factory manual. All malfunctions must be noted and must agree with the findings of the instructor. |
| 6.09 | (Remove and Install Radiators) Given an automobile, access to appropriate tools, equipment, and service manual; remove and replace the radiator in accordance with the manufacturer's service procedure. Upon completion, the radiator and its connecting components will not leak. |

6.10 (Chemically Clean and Flush Cooling System) Given a liquid cooled in operating condition, and access to the appropriate tools, and equipment and a chemical cleaner; chemical clean and flush the cooling system following the manufacturer's procedures.

6.11 (Perform Chemical Test on Coolant System) Using a chemical tester, perform a cylinder leakage test on the cooling system of a given vehicle, following the manufacturer's prescribed procedures. All leaks identified by the instructor must be recognized. The task should be accomplished within ½ hour.

6.12 (Replace Water Pump) Given a liquid cooled engine, and access to necessary tools, equipment, and service manual; replace the water pump in accordance with the manufacturer's specifications. Upon completing the installation, the pump will function as specified without leaks or stoppage.

6.13 (Replace Variable Speed Fan) Given access to necessary tools, equipment, and service manual; replace the variable speed fan on an assigned vehicle, in accordance with the manufacturer's service procedures.

6.14 (Replace Core [Freeze Plugs]) Given an operational engine with a malfunctioning core plug, and access to the appropriate tools and equipment; replace the core plug (freeze plug) in accordance with the manufacturer's service procedure.

6.15 (Solder Minor Leaks in Radiator) Given a radiator with repairable minor leaks, and access to soldering equipment and a service manual; make the required solder repairs to meet industry standards. All leaks identified by the instructor must be recognized and repaired.

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|---|---|---|
| UNIT | 6.0 A | COOLING SYSTEM MAINTENANCE AND REPAIR - LEVEL I |
| TASK | 6.01 | CHECK AND CORRECT COOLANT LEVEL |

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## PERFORMANCE OBJECTIVE:

Given a vehicle and necessary supplies, check and correct the radiator coolant level to manufacturer's specifications.

## PERFORMANCE ACTIONS:

6.0101 Prepare to check and fill coolant level in radiator.

6.0102 Allow system to cool and pressure to reduce.

6.0103 Inspect radiator coolant level. (See Note)

6.0104 If level is low, determine coolant type, and fill to appropriate level for vehicle system.

6.0105 Inspect radiator cap for pressure seal. Replace cap, if necessary.

6.0106 Inspect hoses, etc., for leaks.

## PERFORMANCE STANDARDS:

- Check and fill coolant level in radiator of standard automobile to manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 2 Hours

## RELATED TECHNICAL INFORMATION:

- Coolant types.

(NOTE: For Recovery Systems, check expansion tank level indicators. If filling is necessary, fill to appropriate level.

| | | |
|---|---|---|
| UNIT | 6.0 A | COOLING SYSTEM MAINTENANCE AND REPAIR - LEVEL I |
| TASK | 6.02 | INSPECT, ADJUST, OR REPLACE FAN BELTS |

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PERFORMANCE OBJECTIVE:

Given an automobile, and access to the appropriate service manual, tools, and equipment; inspect, adjust, or remove and replace the fan belt in accordance with the manufacturer's specifications.

PERFORMANCE ACTIONS:

6.0201 Inspect fan belt for wear, fraying, or cracks. Determine if it needs to be removed.

6.0202 Loosen fastener controlling belt tension at top of alternator.

6.0203 Slightly loosen alternator mounting bolts.

6.0204 Using suitable pry, move alternator in toward engine being careful not to damage alternator.

6.0205 Remove fan belt.

6.0206 Install new fan belt.

6.0207 Using suitable pry bar, move alternator outward until proper tension is obtained.

6.0208 Tighten fastener controlling belt tension at top of alternator.

6.0209 Tighten alternator mounting bolts.

6.0210 Recheck belt tension with Strand Belt Gauge or other suitable gauges.

PERFORMANCE STANDARDS:

- Inspect, adjust, or (recommended for training) replace fan belt to manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 6.0 A COOLING SYSTEM MAINTENANCE AND REPAIR - LEVEL I

TASK 6.03 CHECK AND TEST RADIATOR CAP

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PERFORMANCE OBJECTIVE:

Given an automobile, determine if the radiator pressure cap meets manufacturer's specifications by testing the cap with a radiator pressure tester.

PERFORMANCE ACTIONS:

6.0301 Turn radiator cap 1/4 inch turn of lift lever.

6.0302 Remove radiator cap.

6.0303 Wash the cap in water or cleaner to remove dirt and grease.
(NOTE: Compare pressure rating stamped on cap with manufacturer's recommendations).

6.0304 Connect cap to one end of the tester adapter.

6.0305 Connect pressure pump to other end of adapter.

6.0306 Pump pressure until you hear cap exhaust.
(NOTE: Pressure cap should exhaust at specified pressure (stamped on cap).)

6.0307 If cap is good, pressure reading will hold within specified range.
(NOTE: If cap does not hold pressure, replace it.)

6.0308 Replace radiator cap on radiator.

6.0309 Return pressure tester and container to their proper storage place.

PERFORMANCE STANDARDS:

- Pressure test the radiator cap.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 6.0 A COOLING SYSTEM MAINTENANCE AND REPAIR - LEVEL I

TASK 6.04 TEST THE COOLING SYSTEM THERMOSTAT

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PERFORMANCE OBJECTIVE:

Using a thermostat tester or other appropriate method or equipment, test the thermostat for proper operation as designated by the manufacturer's specifications. Readings must be within 5 degrees F of the instructor's readings.

PERFORMANCE ACTIONS:

6.0401 Drain radiator.

6.0402 Remove upper radiator hose.

6.0403 Remove water outlet housing.

6.0404 Remove thermostat.
(NOTE: Note direction that thermostat is facing. It must install in the same way.)

6.0405 Check that thermostat is clean.

6.0406 Locate and note temperature rating stamped on thermostat.

6.0407 Place thermostat in container of hot water.
(NOTE: Suspend thermostat on piece of wire so it does not touch bottom of container. Suspend therometer in water also.)

6.0408 Increase temperature of water and observe thermostat closely.

6.0409 Make note of temperature at which thermostat starts to open. Also note temperature when it is fully open.
(NOTE: Compare temperatures with those specified by manufacturer and stamped on thermostat. If figures do not match, replace thermostat.)

6.0410 Clean water outlet housing surface and manifold surface.

6.0411 Apply gasket cement to both surfaces.

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PERFORMANCE ACTIONS (Con't.):

6.0412 Install thermostat.
(NOTE: Be careful to put it in right side up.)

6.0413 Install gasket and water outlet housing.
(NOTE: Belts should be firm but not too tight. Too much pressure will break housing flanges.)

6.0414 Replace radiator hose and clamp.

6.0415 Fill radiator to (within) one inch of filler opening.

6.0416 Pressure test system for leaks.

PERFORMANCE STANDARDS:

- Test the cooling system thermostat to determine if it meets manufacturer's specifications and replace it if necessary.

SUGGESTED INSTRUCTION TIME: 6 Hours

*NOTE: Primarily, this is theory task, typically, a thermostat is replaced if its operation is questionable.

UNIT 6.0 A COOLING SYSTEM MAINTENANCE AND REPAIR - LEVEL I

TASK 6.05 PRESSURE TEST COOLING SYSTEM

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PERFORMANCE OBJECTIVE:

Given a liquid cooled engine, test the cooling system including the radiator cap, with a pressure tester.

PERFORMANCE ACTIONS:

6.0501 Remove radiator cap.

6.0502 Install radiator tester.

6.0503 Using pressure pump provided, apply specified pressure to the cooling system.

6.0504 While under pressure, check for leaks at hoses, expansion plugs, water pump, radiator, and all cooling components.

6.0505 Note pressure drop on gauge (if any).

PERFORMANCE STANDARDS:

- Pressure test the cooling system of a given automobile (provided with leaks in the cooling system) and identify all leaks.

SUGGESTED INSTRUCTION TIME: 4 Hours

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|---|---|---|
| UNIT | 6.0 A | COOLING SYSTEM MAINTENANCE AND REPAIR - LEVEL I |
| TASK | 6.06 | INSPECT AND REPLACE WATER HOSES |

PERFORMANCE OBJECTIVE:

Using the appropriate hand tools, inspect and replace the upper and lower radiator hoses on an assigned operational engine, in accordance with the manufacturer's service procedures.

PERFORMANCE ACTIONS:

6.0601 Remove any objects that may be necessary to obtain access to the radiator hoses.

6.0602 Remove the upper and lower radiator hoses. (If necessary, cut the old hoses to prevent damage to the radiator outlet.)

6.0603 Clean the water outlet connections to assure a water tight fit.

6.0604 Install new hoses being sure they are properly located before tightening the clamps.

6.0605 Fill the cooling system to the required level with the proper coolant.

6.0606 Pressure test the cooling system for coolant leaks.

6.0607 Run engine to normal operating temperature and recheck coolant level.

PERFORMANCE STANDARDS:

- Inspect and replace the upper and lower radiator hoses on the vehicle provided by the instructor.
- There must be no leaks on completion, and hoses must be undamaged.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 6.0 A — COOLING SYSTEM MAINTENANCE AND REPAIR - LEVEL I

TASK 6.07 — CHECK COOLANT FREEZING POINT

---

## PERFORMANCE OBJECTIVE:

Using an antifreeze tester on a liquid cooled engine at operating temperature, record the freezing point of the cooling solution with 5 degrees F of the instructor's reading.

## PERFORMANCE ACTIONS:

6.0701 Check that coolant level is correct.

6.0702 Insert antifreeze tester into cooling system (radiator cap opening).

6.0703 Determine coolant temperature factor meets manufacturer's recommendations.

## PERFORMANCE STANDARDS:

- Using manufacturer's recommendations, determine the degree of antifreeze protection to (within) 5 degrees F of the instructor's reading.

SUGGESTED INSTRUCTION TIME: 1 Hour

UNIT 6.0 A COOLANT SYSTEM MAINTENANCE AND REPAIR - LEVEL I

TASK 6.08 CHECK OVERFLOW TANK

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PERFORMANCE OBJECTIVE:

On a given automobile equipped with an overflow tank, check the tank for proper operation and mounting as described in the factory manual. All malfunctions must be noted and must agree with the findings of the instructor.

PERFORMANCE ACTIONS:

6.0801 Visually inspect the overflow tank, hoses, and connections for condition and installation.

6.0802 Pressure test the cooling system and radiator cap, if applicable.

6.0803 Determine if the coolant level is correct in the radiator and overflow tank.

6.0804 Run engine to normal operating temperature.

6.0805 Stop engine and allow ample time for the cooling system to reach ambient temperature.

6.0806 Check operation of overflow tank system.

PERFORMANCE STANDARDS:

- Check the overflow tank on a given vehicle and identify any malfunctions.
- The task must be performed in a time considered reasonable (+/- 1/2 hour) by the instructor and findings must agree with those of the instructor.

SUGGESTED INSTRUCTION TIME: 1 Hour

UNIT 6.0 A COOLANT SYSTEM MAINTENANCE AND REPAIR - LEVEL I

TASK 6.09 REMOVE AND INSTALL RADIATORS

---

PERFORMANCE OBJECTIVE:

Given an automobile, access to appropriate tools, equipment, and service manual; remove and replace the radiator in accordance with the manufacturer's service procedure. Upon completion, the radiator and its connecting components will not leak.

PERFORMANCE ACTIONS:

6.0901 Drain cooling system.

6.0902 Remove any component which may prevent access to radiator and hoses.

6.0903 Disconnect upper hose from radiator only.

6.0904 Disconnect lower hose from radiator only.

6.0905 Disconnect transmission cooling lines from radiator, if applicable.

6.0906 Remove cooling shroud, if applicable.

6.0907 Remove radiator mounting bolts.

6.0908 Remove radiator.

6.0909 Install radiator provided and repeat steps 2-8 in reverse order.

6.0910 After filling cooling system, bring it to normal operating temperature, pressure test system, checking for leaks and proper coolant level.

PERFORMANCE STANDARDS:

- Provided an automobile needing radiator replacement, remove the old radiator and replace it with a new one.
- There should be no leaks upon completion of the task.
- The manufacturer's specifications should be met.

SUGGESTED INSTRUCTION TIME: 8 Hours

UNIT 6.0 A COOLANT SYSTEM MAINTENANCE AND REPAIR - LEVEL I

TASK 6.10 CHEMICALLY CLEAN AND FLUSH COOLING SYSTEM

---

PERFORMANCE OBJECTIVE:

Given a liquid cooled engine in operating condition, and access to the appropriate tools and equipment and a chemical cleaner; chemical clean and flush the cooling system following the manufacturer's procedures.

PERFORMANCE ACTIONS:

6.1001 Review chemical product instructions.

6.1002 Following these instructions, chemically clean the cooling system.

6.1003 Refer to the vehicle manufacturer's service procedures for flushing the cooling system.

6.1004 Flush the complete cooling system.

6.1005 Reinstall hose and thermostat as required after flusing and check all connections.

6.1006 Fill the system with the proper coolant to the required level.

6.1007 Pressure test the cooling system to be assured that there are no leaks.

6.1008 Run engine to operating temperature and recheck the coolant level.

PERFORMANCE STANDARDS:

- Provided an automobile whose cooling system requires cleaning, chemical clean and flush the cooling system.
- Meet the manufacturers's specifications.
- Observe proper safety precautions.
- Accomplish the task in a time considered reasonable by the instructor.

SUGGESTED INSTRUCTION TIME: 8 Hours

UNIT 6.0 A COOLANT SYSTEM MAINTENANCE AND REPAIR - LEVEL I

TASK 6.11 (Optional) PERFORM CHEMICAL TEST ON COOLANT SYSTEM

---

PERFORMANCE OBJECTIVE:

Using a chemical tester,* perform a cylinder leakage test on the cooling system of a given vehicle, following the manufacturer's prescribed procedure. All leaks identified by the instructor must be recognized. The task should be accomplished within ½ hour.

PERFORMANCE ACTIONS:

6.1101 Refer to the test procedures outlined by the chemical test manufacturer.

(CAUTION: Adjust the coolant level, if necessary, to be assured that no liquid can be drawn into the tester.)

6.1102 Test system for cylinder leakage following the procedure outlined, with engine operating cold, and again at normal operating temperature.

PERFORMANCE STANDARDS:

- Perform a chemical test on the cooling system of an automobile provided by the instructor and identify any leaks found.
- The task should be performed within ½ hour.
- Follow chemical tester manufacturer's instructions.

SUGGESTED INSTRUCTION TIME: 1 Hour

RELATED TECHNICAL INFORMATION:

- For aluminum radiator, use a cleaner harmless to aluminum.
- Fill system with 50 percent antifreeze (recommended) and 50 percent clean, soft water. Run to normal temperature and fill again, if needed.

*NOTE: Task requires chemical tester.

UNIT 6.0 A COOLANT SYSTEM MAINTENANCE AND REPAIR - LEVEL I

TASK 6.12 REPLACE WATER PUMP

---

PERFORMANCE OBJECTIVE:

Given a liquid cooled engine, and access to necessary tools, equipment, and service manual; replace the water pump in accordance with the manufacturer's specifications. Upon completing the installation, the pump will function as specified without leaks or stoppage.

PERFORMANCE ACTIONS:

6.1201 Drain cooling system.

6.1202 Remove any components which may prevent access to water pump.

6.1203 Disconnect lower radiator hose at water pump.

6.1204 Remove fan assembly and fan pully.

6.1205 Disconnect water pump bypass hose from water pump, if so equipped.

6.1206 Remove water pump.

6.1207 Clean block surfaces of all old gasket material.

6.1208 Install water pump provided using new gasket and proceed with steps 2-6 in reverse order.

6.1209 After cooling system has been filled, pressure test system bringing it up to normal operating temperature and inspect it for leaks and proper coolant level.

PERFORMANCE STANDARDS:

- Replace the water pump on an automobile provided by the instructor.
- Meet manufacturer's specifications.
- There must be no leaks upon completion of the job.

SUGGESTED INSTRUCTION TIME: 16 Hours

UNIT 6.0 A COOLANT SYSTEM MAINTENANCE AND REPAIR - LEVEL I

TASK 6.13 REPLACE VARIABLE SPEED FAN

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PERFORMANCE OBJECTIVE:

Given access to necessary tools, equipment, and service manual; replace the variable speed fan on an assigned vehicle, in accordance with the manufacturer's procedures.

PERFORMANCE ACTIONS:

6.1301 Remove any objects that may prevent access to fan assembly.

6.1302 Loosen alternator tension bolt to take tension off the fan belt.

6.1303 Remove fan assembly mounting bolts and remove fan assembly.

6.1304 Install fan assembly provided reversing the order of steps 1-3.

6.1305 Perform operational check of new fan.

PERFORMANCE STANDARDS:

- Replace the variable speed fan on an automobile provided by the instructor.
- Meet manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 6.0 A COOLANT SYSTEM MAINTENANCE AND REPAIR - LEVEL I

TASK 6.14 REPLACE CORE (FREEZE) PLUGS

---

## PERFORMANCE OBJECTIVE:

Given an operational engine with a malfunctioning core plug, and access to the appropriate tools and equipment; replace the core plug (freeze plug) in accordance with the manufacturer's service procedure.

## PERFORMANCE ACTIONS:

6.1401 Determine which core plug is in need of replacement.

6.1402 If a visual check indicates the need to remove other parts to obtain access to the core plug, refer to the vehicle manufacturer's service manual for removal procedures.

6.1403 Using the appropriate tool, remove the core plug.

6.1404 Clean in and around the core plug hole.

6.1405 Using the proper tool, install the core plug.

6.1406 Fill the cooling system to the required level with the proper coolant.

6.1407 Pressure test the system for leaks.

6.1408 Run the engine to normal operating temperature and recheck the coolant level.

## PERFORMANCE STANDARDS:

- Replace the malfunctioning core plug on an engine provided by the instructor.
- Follow proper procedures for checking leaks and detect leaks if present.
- Follow manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 6 Hours minimum (Task time depends on location of core plug.)

| UNIT/TASK | DESCRIPTION |
|---|---|
| Unit 6.0 B | AUTOMOBILE HEATER MAINTENANCE AND REPAIR |
| 6.01 | (Reverse Flush Cooling System) Given an automobile with operable or malfunctioning heating system, backflush the cooling system following manufacturer's instructions. |
| 6.02 | (Replace Defroster Hose) Given an operational heating system with a defective defroster hose, replace the defroster hose in accordance with the manufacturer's service procedure, making sure there are no leaks when the hose is replaced. |
| 6.03 | (Replace Heater Control Units) Given an operational automobile heating system, the necessary tools, equipment, and service manual; replace the heater control unit. Upon completion, the heater control will operate to the manufacturer's specifications. |
| 6.04 | (Remove and Replace Water Heater Core) Given access to required tools and service manual, and operational heating system with blocked core; remove and replace the heater core according to manufacturer's service procedures. When completed, there must be no leaks or damage in the heater. |
| 6.05 | (Diagnose Heating System Malfunctions) Given an automobile with known malfunctions in the heating system and access to the required tools and equipment, performance test the heating system and identify the malfunctions. All malfunctions identified by the instructor must be recognized. |

UNIT 6.0 B AUTOMOBILE HEATER MAINTENANCE AND REPAIR

TASK 6.01 REVERSE FLUSH COOLING SYSTEM

---

PERFORMANCE OBJECTIVE:

Given an automobile with operable or malfunctioning heating system, backflush the cooling system following manufacturer's instructions.

(NOTE: Some heater systems cannot be reverse flushed. Check manufacturer's recommendations.)

PERFORMANCE ACTIONS:

6.0101 Remove all thermostats from engine block.
(Note: Some cars require removal of water pump as pressure flushing may damage seal.)

6.0102 Attach flushing attachments (gun) to block top water outlet.

6.0103 Attach lead away hose to bottom outlet, if applicable.

6.0104 Reverse flush system.

6.0105 After flushing, attach all hoses securely. Replace any component removed. Fill system with water and antifreeze as needed.

PERFORMANCE STANDARDS:

- On a given automobile, reverse flush the cooling system.
  (NOTE: Some heater systems cannot be reverse flushed. Check manufacturer's recommendations.)

SUGGESTED INSTRUCTION TIME: 6 Hours

UNIT 6.0 B AUTOMOTIVE HEATER MAINTENANCE AND REPAIR

TASK 6.02 REPLACE DEFROSTER HOSE

---

PERFORMANCE OBJECTIVE:

Given an operational heating system with a defective defroster hose, replace the defroster hose in accordance with the manufacturer's service procedure, making sure there are no leaks when the hose is replaced.

PERFORMANCE ACTIONS:

6.0201 Locate defective defroster hose.

6.0202 Remove retaining clamps from defective hose.

6.0203 Remove hose from fittings.

6.0204 Replace new hose over fittings and connect and clamp with retaining clamps.

6.0205 Turn defrost on and check for leaks around hose.

PERFORMANCE STANDARDS:

- On a given automobile with a defective defroster hose, identify the defective hose and replace it so the system works correctly with no leaks.

SUGGESTED INSTRUCTION TIME: 6 Hours

| | | |
|---|---|---|
| UNIT | 6.0 B | AUTOMOTIVE HEATER MAINTENANCE AND REPAIR |
| TASK | 6.03 | REPLACE HEATER CONTROL UNIT |

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PERFORMANCE OBJECTIVE:

Given an operational automobile heating system, the necessary tools, equipment, and service manual; replace the heater control unit. Upon completion, the heater control will operate to the manufacturer's specifications.

PERFORMANCE ACTIONS:

6.0301 Remove fasteners holding the control unit to the dash.

6.0302 Pull the control unit out of the dash (from rear or as appropriate).

6.0303 Remove control cables, one at a time, and attach them to new control units.

6.0304 Put new unit back into proper position under dash, and attach with proper fasteners.

6.0305 Conduct operational check of control unit for proper functioning of all controls in all positions.

PERFORMANCE STANDARDS:

- On a given automobile with a defective part and replace it with a new one.
- The finished job must meet the standards outlined in the manufacturer's service manual or as outlined by the instructor.

SUGGESTED INSTRUCTION TIME: 4 Hours (minimum)

| | | |
|---|---|---|
| UNIT | 6.0 B | AUTOMOTIVE HEATER MAINTENANCE AND REPAIR |
| TASK | 6.04 | REMOVE AND REPLACE WATER HEATER CORE |

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PERFORMANCE OBJECTIVE:

Given access to required tools and service manual, and operational heating system with blocked core; remove and replace the heater core according to manufacturer's service procedures. When completed, there must be no leaks or damage in the heater.

PERFORMANCE ACTIONS:

6.0401 Drain radiator as appropriate.

6.0402 Remove heater hoses at heater.

6.0403 Remove cable and electrical connectors from heater as necessary.

6.0404 Remove retaining fasteners holding heater assemble according to manufacturer's service manual.

6.0405 Pull heater assembly or core from vehicle from driver's side according to manufacturer's service manual.

6.0406 Replace heater core, reversing the removal steps or following manufacturer's service manual.

PERFORMANCE STANDARDS:

- On a given automobile with a blocked heater core, remove the old heater core and install a new one according the the manufacturer's specifications and so that there will be no leaks or damage in the heater.

SUGGESTED INSTRUCTION TIME: 12 Hours

UNIT 6.0 B AUTOMOBILE HEATER MAINTENANCE AND REPAIR

TASK 6.05 DIAGNOSE HEATING SYSTEM MALFUNCTIONS

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PERFORMANCE OBJECTIVE:

Given an automobile with known malfunctions in the heating system and access to the required tools and equipment, performance test the heating system and identify the malfunctions. All malfunctions identified by the instructor must be recognized.

PERFORMANCE ACTIONS:

6.0501 Start vehicle and allow it to reach normal operating temperature.

6.0502 Turn on blowers and operation and volume.

6.0503 Adjust temperature selector and check operation of different functions. (Check door operation.)

6.0504 Check temperature of heater output in closed and wide open positions.

6.0505 Check heater control valve for operation.

6.0506 Check heater hoses (coolant) and ducting for cracks, leaks, and fastenings.

PERFORMANCE STANDARDS:

- On a given automobile with heating system problems, inspect the heating system and diagnose the malfunction(s). The problems identified must agree with the instructor's findings.

SUGGESTED INSTRUCTION TIME: 3 Hours

# TASK LISTINGS
## AUTOMOTIVE MECHANICS

| UNIT/TASK | DESCRIPTION |
|---|---|
| Unit 6.0 C | AUTOMOTIVE AIR CONDITIONER MAINTENANCE AND REPAIR |
| 6.01 | (Check Air Conditioner for Satisfactory Operation) Given an automobile air conditioning system, manufacturer's manual and necessary tools, equipment, and materials and helper if required; check the air conditioner for satisfactory operation. |
| 6.02 | (Discharge Air Conditioning System) On a given automobile air conditioning system, using the tools and equipment necessary; discharge the AC system. |
| 6.03 | (Replace Air Conditioner Fan Motor) Given the necessary tools, equipment, parts, and service manual and an auto air conditioning (or heater)system needing a fan motor replaced; replace the fan motor according to the manufacturer's service procedures so that the motor operates correctly at all speeds with no rattles. |
| 6.04 | (Replace Drier in AC System) Given a service manual for an automobile with faulty AC drier; the necessary tools and equipment; replace the air conditioning receiver drier (dehydrator) on the vehicle in accordance with the manufacturer's specifications. When completed, there will be no air bubbles in the viewing glass. |
| 6.05 | (Replace Extension Valve in AC Unit) Given required tools, equipment, service manual, and an operational AC unit needing servicing; replace the expansion valve on the unit according to the manufacturer's service procedure. The replaced unit must not leak and must function properly. |
| 6.06 | (Replace Compressor Seals) Given necessary tools and equipment, service manual and parts and a AC system needing the compressor shaft seal and O-rings on the compressor replaced, replace the compressor seals. Work must be done in accordance with manufacturer's specifications and there must be no leaks around the seals. |
| 6.07 | (Replace Condenser Assembly in Air Conditioning Unit) Given necessary tools, equipment, service manual, and replacement condenser assembly; replace the AC condenser assemble on a given automobile in accordance with manufacturer's specifications. When completed, there will be no leaks in the condenser, and it will not touch the radiator. |

6.08 (Replace POA Valve) Given a vehicle with a malfunctioning POA control valve, and access to a service manual and the necessary tools and equipment; replace the POA valve according to manufacturer's specifications.

6.09 (Replace Air Conditioner Compressor) Given access to required tools, equipment, service manual, a replacement air conditioner compressor, and an automobile AC system with a bad compressor; replace the air conditioner compressor on a given automobile according to manufacturer's service manual.

6.10A (Pressure Test and Leak Test AC System) Given access to necessary tools, equipment, and service manual, install a manifold gauge set on assigned air conditioning unit and compare the pressure readings to the manufacturer's specifications.

6.10B Given a leak detector, necessary tools, equipment, and service manual, test for refrigerant leaks on an assigned air conditioning unit in accordance wih manufacturer's specifications.

6.11 (Diagnose Air Conditioning Malfuncations) Given an air conditioning system with known malfunctions, a service manual, and the necessary tools and equipment; identify the malfunctions that exist in the unit. All malfunctions known by the instructor must be identified. Time limit is one hour.

6.12 (Repair AC Electrical Circuits) Given the necessary tools and equipment, service manual, and a malfunctioning AC unit electrial system; repair the circuit according to the manufacturer's specifications.

6.13 (Repair Vacuum Circuits) Given access to necessary tools, equipment, service manual, and a malfunctioning automotive air conditioning vacuum circuit; repair the vacuum circuit in accordance with the manufacturer's specifications. The repaired system should function properly and have no leaks.

6.14 (Inspect and Recharge Air Conditioning System With Refrigerant) Given an automobile with air conditioning system needing refrigerant system recharging, appropriate service manual, required tools and equipment; charge an evalcuated air conditioning system with refrigerant according to manufacturer's specifications. When completed, there will be no bubbles in the drier viewing window.

6.15 (Evacuate AC System) Given an automobile with air conditioner, appropriate tools, equipment and service manual; evacuate the air condition system in accordance with manufacturer's specifications and procedures. When completed, there will be no coolant remaining in the AC system.

UNIT 6.0 C AUTOMOBILE AIR CONDITIONER MAINTENANCE AND REPAIR

TASK 6.01 CHECK AIR CONDITIONER FOR SATISFACTORY OPERATION

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PERFORMANCE OBJECTIVE:

Given an automobile air conditioning system, manufacturer's manual and necessary tools, equipment, and materials and helper if required; check the air conditioner for satisfactory operation.

PERFORMANCE ACTIONS:

6.0101 Operate the system to check if system is operating correctly.

6.0102 If malfunctioning is suspected, check drive belt condition and tension.

6.0103 Check compressor magnetic clutch operation.

6.0104 Check sight glass, if equipped.

6.0105 Check system lines and connections.

6.0106 Check air flow system.

6.0107 Follow manufacturer's diagnosis chart for further system checks.

PERFORMANCE STANDARDS:

- On a given automotive air conditioner, follow manufacturer's diagnosis chart to determine if system is operating satisfactorily.
- Findings must agree 100 percent with instructor's diagnosis.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 6.0 C AUTOMOBILE AIR CONDITIONER MAINTENANCE AND REPAIR

TASK 6.02 DISCHARGE AIR CONDITIONING SYSTEM

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PERFORMANCE OBJECTIVE:

On a given automobile air conditioning system, using the tools and equipment necessary; discharge the AC system.

PERFORMANCE ACTIONS:

6.0201 Check system for leaks before discharging.

6.0202 Determine if system:
  a. Equipped with hand operated service valves
  b. Equipped with Schrader valve service fittings

6.0203 a. Discharging hand valve system:
  1. Connect gauge set.
  2. Open manifold high-pressure valve, keep low-pressure valve closed.
  3. Crack the service discharge valve allowing refrigerant to slowly escape (thru exhaust system).*

b. Discharging Schrader Valve Service Fittings:
  1. Connect gauge set with both valves closed.
  2. Crack manifold high-pressure gauge valve allowing refrigerant to slowly escape (thru exhaust outlet...not in service area).*
  3. When high-pressure gauge reads less than 100 psi, crack low-pressure gauge valve until all pressure is removed.

PERFORMANCE STANDARDS:

- On a given AC system, discharge the system of refrigerant, being careful not to remove any oil during the process.

SUGGESTED INSTRUCTION TIME: 2 Hours

(CAUTION: Fast discharging may draw oil from system.)

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|---|---|---|
| UNIT | 6.0 C | AUTOMOTIVE AIR CONDITIONER MAINTENANCE AND REPAIR |
| TASK | 6.03 (Optional) | REPLACE FAN MOTOR |

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PERFORMANCE OBJECTIVE:

Given the necessary tools, equipment, parts, and service manual and an auto air conditioning (or heating) system needing a fan motor replaced; replace the fan motor according to the manufacturer's service procedures so that the motor operates correctly at all speeds with no rattles.

PERFORMANCE ACTIONS:

6.0301 Disconnect power to unit.

6.0302 Disconnect bolting around cable.

6.0303 Disconnect blower motor wires.

6.0304 Remove attaching screws.

6.0305 Remove blower motor and fan assembly.

6.0306 Remove fan.

6.0307 Replace motor.

6.0308 Using the reverse steps, install the replacement motor.

PERFORMANCE STANDARDS:

- Replace the air conditioning fan motor in a given vehicle following the manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 10 Hours*

*Depends on type vehicle installation.

UNIT 6.0 C AUTOMOBILE AIR CONDITIONER MAINTENANCE AND REPAIR

TASK 6.04 REPLACE DRIER IN AC SYSTEM

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PERFORMANCE OBJECTIVE:

Given a service manual for an automobile with a faulty AC drier, the necessary tools and equipment; replace the air conditioning receiver drier (dehydrator) on the vehicle in accordance with the manufacturer's specifications. When completed, there will be no air bubbles in the viewing glass.

PERFORMANCE ACTIONS:

6.0401 Install manifold gauge set.

6.0402 Release refrigerant charge slowly.

6.0403 Disconnect high and low pressure coolant lines.

6.0404 Move condenser to allow access to drier.

6.0405 Replace drier.

6.0406 Reconnect system in reverse order.

6.0407 Perform operational check for leaks and proper operation.

PERFORMANCE STANDARDS:

- Replace AC receiver drier (dehydrator) on given vehicle.
- Replaced unit must not leak and must perform satisfactorily.

SUGGESTED INSTRUCTION TIME: 6 Hours

UNIT 6.0 C AUTOMOBILE AIR CONDITIONER MAINTENANCE AND REPAIR

TASK 6.05 REPLACE EXPANSION VALVE IN AC UNIT

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PERFORMANCE OBJECTIVE:

Given required tools, equipment, service manual, and an operational AC unit needing servicing; replace the expansion valve on the unit according to the manufacturer's service procedure. The replaced unit must not leak and must function properly.

PERFORMANCE ACTIONS:

6.0501 Install manifold gauge set.

6.0502 Release refrigerant charge slowly (not in service area).

6.0503 Disconnect equalizer line and expansion valve.

6.0504 Pull out sensing tube carefully from suction line well.

6.0505 Remove rubber seal from sending tube.

6.0506 Replace expansion valve and reassemble unit reverse order.

6.0507 Perform operating test for leaks and proper functioning of unit.

PERFORMANCE STANDARDS:

- Replace expansion valve in AC unit provided by the instructor.
- The replaced unit must function properly with no leaks.

SUGGESTED INSTRUCTION TIME: 6 Hours

UNIT 6.0 C AUTOMOTIVE AIR CONDITIONER MAINTENANCE AND REPAIR

TASK 6.06 (Optional) REPLACE COMPRESSOR SEALS

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PERFORMANCE OBJECTIVE:

Given necessary tools and equipment, service manual and parts and a AC system needing the compressor shaft seal and O-rings on the compressor replaced, replace the compressor seals. Work must be done in accordance with manufacturer's specifications and there must be no leaks around the seals.

PERFORMANCE ACTIONS:

6.0601 Install manifold gauge set.

6.0602 Release refrigerant charge slowly.

6.0603 Following manufacturer's shop manual, remove:
a. Clutch lock nut.
b. Clutch driven plate.
c. Seal seat retainer ring.
d. Seal seat.
e. Shaft seal.
f. "O" ring.
g. Then, reinstall by reversing the process and being sure the compressor neck is thoroughly clean.

PERFORMANCE STANDARDS:

- Install the compressor shaft seal and "O" rings on a given auto AC system requiring new seals.
- Work must be done to the manufacturer's specifications and there should be no leaks around the compressor seals.

SUGGESTED INSTRUCTION TIME: 6 Hours

| | | |
|---|---|---|
| UNIT | 6.0 C | AUTOMOBILE AIR CONDITIONER MAINTENANCE AND REPAIR |
| TASK | 6.07 | REPLACE CONDENSER ASSEMBLY IN AIR CONDITIONING UNIT |

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PERFORMANCE OBJECTIVE:

Given necessary tools, equipment, service manual, and replacement condenser assembly; replace the AC condenser assembly on a given automobile in accordance with manufacturer's specifications. When completed, there will be no leaks in the condenser, and it will not touch the radiator.

PERFORMANCE ACTIONS:

6.0701 Install manifold gauge set.

6.0702 Slowly release refrigerant charge.

6.0703 Remove receiver drier if attached.

6.0704 Remove condenser bolts and condenser from vehicle.

6.0705 Reverse the procedure to reinstall the condenser or a new condenser assembly.

PERFORMANCE STANDARDS:

- Replace the condenser assembly in a given automobile air conditioning system.

SUGGESTED INSTRUCTION TIME: 6 Hours

| | | |
|---|---|---|
| UNIT | 6.0 C | AUTOMOBILE AIR CONDITIONER MAINTENANCE AND REPAIR |
| TASK | 6.08 | REPLACE POA VALVE IN AC UNIT |

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PERFORMANCE OBJECTIVE:

Given a vehicle with a malfunctioning POA valve, and access to a service manual and the necessary tools and equipment; replace the POA valve according to manufacturer's specifications.

PERFORMANCE ACTIONS:

6.0801 Install manifold gauge set.

6.0802 Release refrigerant charge slowly.

6.0803 Remove POA valve.

6.0804 Reinstall POA valve.

6.0805 Recharge system with refrigerant.

6.0806 Perform operational test and check for leaks and proper functioning.

PERFORMANCE STANDARDS:

- On a given vehicle with a malfunctioning POA valve; replace the POA valve so the unit functions properly with no leaks.

SUGGESTED INSTRUCTION TIME: 6 Hours

UNIT 6.0 C AUTOMOBILE AIR CONDITIONER MAINTENANCE AND REPAIR

TASK 6.09 REPLACE AIR CONDITIONER COMPRESSOR

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PERFORMANCE OBJECTIVE:

Given access to required tools, equipment, service manual, a replacement air conditioner compressor, and an automobile AC system with a bad compressor; replace the air conditioner compressor on a given automobile according to manufacturer's service manual.

PERFORMANCE ACTIONS:

6.0901 Locate and follow manufacturer's procedure for replacing the AC compressor.

6.0902 Evacuate AC system.

6.0903 Remove and replace AC compressor.

6.0904 Recharge system.

6.0905 Performance test AC unit.

PERFORMANCE STANDARDS:

- Replace AC compressor on a given automobile following manufacturer's procedures and meeting instructor's standards.

SUGGESTED INSTRUCTION TIME: 6 Hours

| | | |
|---|---|---|
| UNIT | 6.0 C | AUTOMOTIVE AIR CONDITIONER MAINTENANCE AND REPAIR |
| TASK | 6.10 A & B | PRESSURE TEST AND LEAK TEST AC SYSTEM |

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PERFORMANCE OBJECTIVES:

A. Given access to necessary tools, equipment, and service manual, install a manifold gauge set on assigned air conditioning unit and compare the pressure readings to the manufacturer's specifications.

PERFORMANCE ACTIONS:

6.1001 Consult manufacturer's service manual to obtain pressure specifications.

6.1002 Connect manifold gauge set.

6.1003 Purge air from service lines and position service valves (to cracked position).

6.1004 With engine running at fast idle and air conditioning unit on, allow at least 5 minutes for unit to stablize.

6.1005 Record pressure readings and ambient temperatures.

6.1006 Compare readings to specifications to determine if unit is functioning properly.

B. Given a leak detector, necessary tools, equipment, and service manual; test for refrigerant leaks on an assigned air conditioning unit in accordance with manufacturer's specifications.

PERFORMANCE ACTIONS:

6.1001 Run engine at fast idle.

6.1002 Operate AC unit, allowing time for unit to stablize.

6.1003 Check sight glass to ensure ample charge exists.

6.1004 Allow AC unit to operate on high blower for about 10 minutes with windows and door open.

6.1005 Shut off AC unit and engine and allow time for pressure to equalize.

UNIT 6.0 C AUTOMOTIVE AIR CONDITIONER MAINTENANCE AND REPAIR

TASK 6.10 A & B PRESSURE TEST AND LEAK TEST AC SYSTEM (Con't.)

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PERFORMANCE ACTIONS (Con't.):

6.1006 Using leak detector, check all components of system for refrigerant leaks.

PERFORMANCE STANDARDS:

- On a given automobile air conditioning system, pressure test and leak test the system and report findings to the instructor.
- Findings should agree with the instructor's findings.

SUGGESTED INSTRUCTION TIME: 3 Hours

UNIT 6.0 C AUTOMOBILE AIR CONDITIONER MAINTENANCE AND REPAIR

TASK 6.11 DIAGNOSE AIR CONDITIONING MALFUNCTIONS

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PERFORMANCE OBJECTIVE:

Given an air conditioning system with known malfunctions, a service manual, and the necessary tools and equipment; identify the malfunctions that exist in the unit. All malfunctions known by the instructor must be identified. Time limit is one hour.

PERFORMANCE ACTIONS:

6.1101 Perform visual test in accordance with manufacturer's automotive service manual.

6.1102 Install manifold gauge set on the air conditioning unit to determine pressure readings.

6.1103 Check sight glass for ample refrigerant charge.

6.1104 Check electrical system with volt ohmmeter following proper troubleshooting techniques (procedures).

PERFORMANCE STANDARDS:

- On a given automotive AC system with known malfunctions, identify the malfunctions that exist in the unit within one hour.

SUGGESTED INSTRUCTION TIME: 2 Hours

| | | |
|---|---|---|
| UNIT | 6.0 C | AUTOMOTIVE AIR CONDITIONER MAINTENANCE AND REPAIR |
| TASK | 6.12 (Optional) | REPAIR AC ELECTRICAL CIRCUITS |

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## PERFORMANCE OBJECTIVE:

Given the necessary tools and equipment, service manual, and a malfunctioning AC unit electrical system; repair the circuit according to the manufacturer's specifications.

## PERFORMANCE ACTIONS:

6.1201 Perform operational check on AC system.

6.1202 Check for:
- a. Blown fuses.
- b. Disconnected or broken positive wire.
- c. Disconnected or broken ground wire.
- d. Clutch coil.
- e. Switch contacts.
- f. Blower motor for defects.

6.1203 Isolate problem and repair or replace defective item(s).

## PERFORMANCE STANDARDS:

- On an instructor provided vehicle with a malfunction in the air conditioning electrical circuit, locate the problem and repair the circuit.

SUGGESTED INSTRUCTION TIME: 2 Hours (Minimum)*

*Depends on student's ability and training emphasis.

UNIT 6.0 C AUTOMOTIVE AIR CONDITIONER MAINTENANCE AND REPAIR

TASK 6.13 (Optional) REPAIR VACUUM CIRCUITS

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PERFORMANCE OBJECTIVE:

Given access to necessary tools, equipment, service manual, and a malfunctioning automotive air conditioning vacuum circuit; repair the vacuum circuit in accordance with the manufacturer's specifications. The repaired system should function properly and have no leaks.

PERFORMANCE ACTIONS:

6.1301 Place air conditioning system into operation.

6.1302 Check hoses and fittings for leaks.

6.1303 Check evaporator for proper operation and leaks.

6.1304 Check expansion valve for defects.

6.1305 Isolate defects and repair or replace components as necessary.

6.1306 Perform operational test for proper functioning of system and check for leaks.

PERFORMANCE STANDARDS:

- On an instructor provided auto air conditioning system with a malfunction in the air conditioning vacuum circuit; locate the problem and repair it so there are no leaks and the system functions properly.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 6.0 C AUTOMOBILE AIR CONDITIONER MAINTENANCE AND REPAIR

TASK 6.14 INSPECT AND RECHARGE AIR CONDITIONING SYSTEM WITH REFRIGERANT

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PERFORMANCE OBJECTIVE:

Given an automobile with air conditioning system needing refrigerant system recharging, appropriate service manual, requiring tools and equipment; charge an evalcuated air conditioning system with refrigerant according to manufacturer's specifications. When completed, there will be no bubbles in the driver viewing window.

PERFORMANCE ACTIONS:

6.1401 Consult manufacturer's service manual for the amount of refrigerant needed.

6.1402 Install manifold gauge set on air conditioning unit and to refrigerant supply.

6.1403 Purge all air from service lines.

6.1404 Charge all air from service lines.

6.1405 Check sight glass for clear flow (no air bubbles), if equipped.

6.1406 Performance test air conditioner.

PERFORMANCE STANDARDS:

- On a given automobile air conditioning system, evacuate and recharge the refrigerant to the manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 2 Hours

RELATED TECHNICAL INFORMATION:

- Always wear protective goggles when servicing refrigeration system.
- Service the AC system in a well-ventilated area.
- Do not discharge refrigerant (R-12) directly into service area.
- Keep refrigerant from skin.
- Observe standard safety precautions in handling refrigerant.
- Allow for refrigerant expansion when refilling containers.

UNIT 6.0 C AUTOMOBILE AIR CONDITIONER MAINTENANCE AND REPAIR

TASK 6.15 EVACUATE AC SYSTEM

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PERFORMANCE OBJECTIVE:

Given an automobile with air conditioner, appropriate tools, equipment and service manual; evacuate the air condition system in accordance with manufacturer's specifications and procedures. When completed, there will be no collant remaining in the AC system.

PERFORMANCE ACTIONS:

6.1501 Consult manufacturer's service manual for evacuation procedures.

6.1502 Close manifold gauge, set hand valve.

6.1503 Put on eye safety goggles.

6.1504 Remove service valve caps and install appropriate manifold gauge set.

6.1505 Position hand operated type service valves to mid (cracked) position.

6.1506 Purge system of all refrigerant if gauges indicate pressure by opening low side manifold valve to center hose.

6.1507 Connect vacuum pump to center hose and allow it to work a minimum of one-half (1/2) hour.

6.1508 Close manifold hand valves turn off and disconnect vacuum pump, and observe low side gauge for leaks.

PERFORMANCE STANDARDS:

- Evacuate/discharge AC system in given automobile following manufacturer's instructions.

SUGGESTED INSTRUCTION TIME: 2 Hours

# TASK LISTINGS
## AUTOMOTIVE MECHANICS

| UNIT/TASK | DESCRIPTION |
|---|---|
| Unit 7.0 | ELECTRICAL AND IGNITION SYSTEMS |
| 7.01 | (Check Spark Plugs and Replace as Needed) Provided with an automobile needing spark plug service, and access to the appropriate tools, equipment, and service manual; check spark plugs and replace them as necessary according to the manufacturer's specifications. |
| 7.02 | (Check Spark Plug Wiring) Given an automobile engine with questionable spark plug wiring, check the spark plug wiring to ensure that it meets manufacturer's specifications. |
| 7.03 | (Clean and Replace Distributor Cap Towers, Wiring, and Other Minor Electrical Units) Given an automobile with a distributor cap towers, wiring, and other minor electrical units necessary for the automobile distributor (electrical) system to function properly. Manufacturer's specifications must be met. |
| 7.04 | (Inspect, Adjust, Remove, and Replace Alternator Belt) Given an automobile with an alternator charging system, proper tools, equipment, parts, and service manual; inspect, adjust, and replace if necessary the alternator charging system belt. When completed the belt condition will be checked for servicability, tension checked, and bolts checked for security. |
| 7.05 | (Test, Service, or Replace Batteries, Cables, and Battery Boxes) Given an automobile and battery requiring servicing or checking; provide maintenance for the battery and associated holder/case; check the battery cell electrolyte level, test the specific gravity of the battery, test the battery voltage, and charge a battery. Performance must be to manufacturer's specifications and to instructor's standards. |
| 7.06 | (Perform Operational Inspection of Lighting Sytem: Replace Bulbs, Flashers, and Fuses as Necessary) Given a vehicle and service manual, check the operation of all exterior lights and control switches and determine if they are operating in accordance with the manufacturer's standards. Replace bulbs, flashers, and fuses as necessary. |
| 7.07 | (Test and Replace Fuses) On a given automobile, test and replace fuses using the manufacturer's specifications (owner's manual, or other data), instructor provided parts, tools, and equipment. |
| 7.08 | (Replace Flasher Units) Given a defective flasher unit in an automobile, and using the required tools and service manual; replace the flasher unit in accordance with manufacturer's specifications. |

7.09 (Adjust Backup Light Switches) Given a vehicle with an incorrectly adjusted backup light switch, and the necessary hand tools, and service manual; adjust the switch to a working order which meets manufacturer's specifications.

7.10 (Adjust Headlights) Given an automobile and headlight tester, adjust the automobile headlights to meet state requirements using the Headlight Tester in accordance with given procedures.

7.11 (Set Ignition Timing) Given an operational engine, service manual, and access to the necessary tools and equipment, set the ignition timing in accordance with the manufacturer's specifications. Timing must be within +/- 1 degree of manufacturer's specifications.

7.12 (Replace Alternators) Given necessary tools, equipment, and service manual, install an alternator on a vehicle provided by the instructor meeting the manufacturer's specifications. Upon completion, the alternator will operate without noise or shimmying.

7.13 (Replace Starters) Given access to the necessary tools and equipment, and a service manual; replace the starter on an assigned vehicle and make the required tests to determine if the operation is in accordance with the manufacturer's specifications.

7.14 (Replace Starter Solenoid) Provided the necessary tools, equipment, service manual and a vehicle with a defective solenoid, replace the solenoid in accordance with manufacturer's specifications.

7.15 (Repair Alternators) Given a malfunctioning repairable alternator, the proper tools and equipment, and service manual; complete the necessary repairs on the alternator. Identification of the problem(s) must conform to the instructor's diagnosis, and repairs must be within the manufacturer's specifications.

7.16 (Analyze Malfunctions in the Cranking System) Given a vehicle with a malfunction in the cranking circuit, a service manual, and access to the necessary test equipment and hand tools, isolate the malfunction and estimate the required repair needed to meet the manufacturer's specifications. Identification of the problem and the repair needed to correct it must be the same as the instructor's findings.

7.17 (Replace and Adjust Distributors) Using required equipment, tools, and ignition distributor, replace the distributor on an operational engine in accordance with the manufacturer's specifications.

7.18 (Repair or Replace Switches) Given an automobile with various types of electrical switches of which some are known to be defective, the necessary test equipment and a service manual; identify the defective switches and replace them as necessary.

7.19 (Repair Windshield Wiper Mechanisms and Controls) Using the required tools, service manual, and an automobile with malfunctioning windshield wiper mechanisms and controls; repair all malfunctions in accordance with manufacturer's specifications. Upon completion, the wiper must operate as prescribed in the manufacturer's operating instructions.

7.20 (Repair or Replace Fuse Box Assembly) Provided a vehicle with a malfunction in the fuse block, the necessary tools and equipment, and a service manual; repair or replace the fuse block as is required in the manufacturer's specifications.

7.21 (Replace Chassis and Underhood Wiring) Given access to the required tools, equipment, ervice manual, wiring harness and an automobile; replace the chassis and underhood wiring in accordance with manufacturer's procedures. All replacements must conform to specifications set forth in the vehicle's service manual.

7.22 (Test and Rewire Dash Units) Given a vehicle with a known malfunction in the dash unit, the proper tools and equipment, and service manual; locate the malfunction and make the required repairs in accordance with manufacturer's specifications.

7.23 (Analyze Cause of Electrical Malfunction) Given a vehicle with a defective electrical circuit and a service manual, determine the cause of the problem and estimate the required repairs in accordance with the manufacturer's specifications. The cause and the required repairs identified must agree with the instructor's findings.

7.24 (Replace Ignition Switch and Resistor) Given access to required tools, ignition switch, ignition resistor, and an operational automobile; replace the ignition switch and resistor in accordance with the manufacturer's specifications. The automobile ignition system must meet the manufacturer's service manual.

7.25 (Evaluate Alternator, and Regulator Output) Given necessary diagnostic test equipment, tools and specifications manual, test charging circuit on a given automobile to determine if its performance is in accordance with manufacturer's specifications.

7.26 (Repair or Replace Charging System Regulator) Given a vehicle with trouble in the voltage regulator, the necessary test equipment and tools, and a service manual; locate the problem and repair or replace the component(s) as required by manufacturer's specifications.

7.27 (Analyze or Adjust Engine Performance Using Engine Analyzer) Assigned an engine analyzer, vehicle, service manual, and the necessary tools; test and perform minor adjustments as required on an assigned vehicle in accordance with the manufacturer's specifications. All adjustments identified by the instructor must be recognized and performed.

7.28 (Strobe Distributor and Modify/Correct Advance Curves) Given a distributor, necessary equipment, and required tools, place distributor in machine and check timing and dwell angle and make adjustments in accordance with the manufacturer's specifications.

7.29 (Inspect Secondary Circuit Lead Wires, Distributor Cap, and Rotor, and Measure Secondary Wire Resistance) Given an automobile, visually inspect the secondary wires, distributor cap and rotor. Make an ohmmeter check to determine if replacement is necessary to meet manufacturer's specifications. All defects identified by the instructor must be identified.

7.30 (Inspect Ignition Switch, Resistor, Wiring, and Coil of the Primary Circuit) Given the necessary test equipment and the components of a primary circuit (ignition switch, resistor, wiring, and coil), visually inspect and make tests to determine if each unit meets the manufacturer's specificatins. Any malfunctions indentified by the instructor must be recognized.

7.31 (Replace Coil of the Primary Circuit) Provided with a new ignition coil, access to necessary tools, and an operational engine; replace the ignition coil in accordance with the manufacturer's service procedures. The new coil must be operational and meet the specifications set forth in the manufacturer's service manual.

7.32 (Locate and Repair Shorts and Open Circuits in Wiring) Given a vehicle with a shorted wire or open circuit, the necessary tools and test equipment, and a service manual; locate and repair the short or open circuit to meet the manufacturer's specifications.

7.33 (Test and Repair Electronic Ignition Systems) Given a vehicle with a malfunction in the electronic ignition, and the proper test equipment and tools; isolate the malfunction and repair or replace components as required, in accordance with the manufacturer's specifications.

7.34 (Inspect Points and Condenser of Primary Circuit) Given a distributor, inspect the contact points and the condenser using an ohmmeter and determine if replacement is required to meet the manufacturer's specifications. The task should be accomplished satisfactorily.

7.35 (Replace Points and Condenser [Tune-up]) Given access to the required tools, equipment, ignition points, condenser and an operational engine; replace the ignition points and condenser in accordance with the manufacturer's specifications. The degrees of dwell must be within 2 degrees of the manufacturer's specifications.

7.36 (Overhaul Distributor) Given a malfunctioning distributor and the necessary tools and equipment, overhaul the distributor and calibrate in accordance with the manufacturer's specifications. The degrees of dwell must be within +/- 2 degrees of the manufacturer's specifications.

7.37 (Perform Complete Engine Tune-up) Given an automobile needing a complete engine tune-up, the necessary specifications, tools and diagnostic equipment, and repair or replacement parts; perform a complete engine tune-up so that the automobile operates to manufacturer's specifications and to the standards of the instructor (service foreman).

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|---|---|---|
| UNIT | 7.0 | ELECTRICAL AND IGNITION SYSTEMS<br>LEVEL I |
| TASK | 7.01 | CHECK SPARK PLUGS AND REPLACE<br>AS NEEDED |

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PERFORMANCE OBJECTIVE:

Provided with an automobile needing spark plug service, and access to the appropriate tools, equipment, and service manual; check spark plugs and replace them as necessary according to the manufacturer's specifications.

PERFORMANCE ACTIONS:

7.0101 Disconnect leads from spark plugs.

7.0102 Remove all spark plugs, noting the cylinder in which they were installed.

7.0103 Observe the condition of the spark plugs. If they are excessively worn, replace them with similar plugs according to manufacturer's specifications.

7.0104 Clean excessive carbon or lead deposits from spark plug tips, if applicable.

7.0105 Set gap on plugs.

7.0106 Lightly coat spark plug threads with engine oil and install plugs. Be careful not to overtorque the spark plugs (See manufacturer's service information for torque specifications.).

7.0107 Check spark plug leads for cracks and brittleness, then reconnect the leads to the spark plugs.

7.0108 Performance test the automobile for proper operation.

PERFORMANCE STANDARDS:

- Check spark plugs and replace them as necessary in an automobile provided by the instructor.

SUGGESTED INSTRUCTION TIME: 3 Hours

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL I

TASK 7.02 CHECK SPARK PLUG WIRING

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## PERFORMANCE OBJECTIVE:

Given an automobile engine with questionable spark plug wiring, check the spark plug wiring to ensure that it meets manufacturer's specifications.

## PERFORMANCE ACTIONS:

7.0201 Assemble ohmmeter with test leads, test lead with alligator clip to one or both ends.

7.0202 Disconnect each spark plug wire, one at a time or as a set.

7.0203 Clean cables with kerosene moistened rag and wipe clean with dry rag.

7.0204 Inspect entire length of cables.
- Discard cable if cracks are apparent, if insulation is brittle, or if insulation is chafed.

7.0205 Check spark-plug boots and replace cable if they are brittle or cracked.

7.0206 Examine terminals on each end. If eroded from burning, replace cable.
(NOTE: Burning indicates that cable was not fully seated in terminal.)

7.0207 Using ohmmeter, check cables for high resistance. Suggested ohmmeter test:
a. With ohmmeter leads connected to each end of spark plug cables, check for a resistance of not more than 30,000 Ohms for a cable 25 inches or less and 50,000 Ohms for a cable over 25 inches. If cable exceeds the suggested high resistance ohm reading, replace it.
b. Cable between coil and distributor cap may be checked in the same way. Combined resistance of cable and distributor cap should not be more than 25,000 ohms. The cable, itself, should not be more than 15,000 ohms and, if more, replace it.

7.0208 Next, install cables on vehicle engine. Start engine.

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PERFORMANCE ACTIONS (Con't.):

7.0209 Using a probe (commercial or one assembled from a screwdriver with a wire clipped to it and the other end of the wire clipped to the engine block or ground), disconnect a spark plug cable and position the cable so it does not ground. Next probe around the cable and book with the grounded screwdriver to inspect for spark jumps from defective areas. If defective areas are found, discard the cable.

PERFORMANCE STANDARDS:

- Check spark plug wiring visually, using an ohmmeter, and, if looking for defective areas, by using a grounding probe.
- Cables should be clean, free of cracks, breaks, and brittle areas.
- Terminals should be clean and electrically sound.
- Cable high resistance check should be at proper levels.

SUGGESTED INSTRUCTION TIME: 3 Hours

RELATED TECHNICAL INFORMATION:

- Use of Ohmmeter.
- Proper cable resistance.

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL I

TASK 7.03 CLEAN AND REPLACE DISTRIBUTOR CAP
TOWERS, WIRING, AND OTHER MINOR
ELECTRICAL UNITS

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PERFORMANCE OBJECTIVE:

Given an automobile with a distributor electrical system to service, clean and replace the distributor cap towers, wiring, and other minor electrical units necessary for the automobile distributor (electrical) system to function properly. Manufacturer's specifications must be met.

PERFORMANCE ACTIONS:

7.0301 Clean coil and inspect coil tower for cracks or wear (eroded appearance).
  a. Clean deposits from inside tower with proper cleaning tool.
  b. If coil needs replacement, unseat old unit from bracket and install new unit, reattaching wires.

7.0302 Remove distributor cap clips or spring hold downs. Lift cap from distributor and wipe it clean.

7.0303 Examine cap for cracks, chips, broken towers, worn/burned contacts, burned terminals in towers, and carbon tracks. Replace the distributor cap if it shows any sign of damage. (Terminals that are only dirty or corroded should be cleaned and returned to service.)

7.0304 Remove rotor from top of distributor shaft. Wipe rotor clean and examine it for cracks and corrosion. Check for metal damage and replace the rotor if damage is found.

7.0305 Remove radio-frequency shield from inside housing if so equipped.

7.0306 Test operation of centrifugal advance mechanism. (Centrifugal advance mechanism may be observable or it may not be.)

7.0307 Test operation of centrifugal advance mechanism. If the mechanism sticks or is sluggish, the distributor should be overhauled.

7.0308 Test vacuum advance mechanism. Replace faulty distributor vacuum advance mechanism after vacuum line

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS LEVEL I

TASK 7.03 CLEAN AND REPLACE DISTRIBUTOR CAP TOWERS, WIRING, AND OTHER MINOR ELECTRICAL UNITS (Con't.)

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PERFORMANCE ACTIONS (Con't.):

has been checked to ensure that it is not cracked, loose, or leaking.

a. To replace the vacuum advance mechanism, the distributor generally must come off the engine. (NOTE: Rotor must be returned to distributor in exact position as removed. Scribe a line on rotor and distributor to help ensure lineup.) Unbolt and remove distributor from engine.

b. Locate fasteners holding vacuum advanced to distributor housing. Remove bolts and slide unit away from distributor. Replace unit. Reassemble.

7.0309 Continue tune-up service. Examine distributor breaker points. Clean points slightly if coated, burned or pitted. Replace badly burned or pitted points.

7.0310 Clean breaker plate and lubricate cam or replace wick-type cam lubricator.

7.0311 Install point assembly and new condenser (with new points). Gap to specifications. Remove any residue from points after gapping.

7.0312 Lubricate distributor rotor if appropriate.

7.0313 Replace distributor cap, install cables, and test engine operation.

PERFORMANCE STANDARDS:

- On a given automobile; clean or replace distributor cap towers, wiring and other minor electrical units as necessary. The repaired distributor must operate properly and meet manufacturer's specifications upon completion.

SUGGESTED INSTRUCTION TIME: 6 Hours

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL I

TASK 7.04 INSPECT, ADJUST, REMOVE, AND REPLACE
ALTERNATOR BELT

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PERFORMANCE OBJECTIVE:

Given an automobile with and alternator charging system, proper tools, equipment, parts, and service manual; inspect, adjust, and replace if necessary the alternator charging system belt. When completed, the belt condition will be checked for servicability, tension checked, and bolts checked for security.

PERFORMANCE ACTIONS:

7.0401 Inspect alternator belt for cracking, loosening, glaze, fraying or other damage. Loosen alternator adjusting arm bracket bolts.

7.0402 Push alternator toward fan and crankshaft pullys until belt slackens. Remove old belt if replacement is necessary.

7.0403 Worm new belt over fan and crankshaft pulleys and around alternator pulley.

7.0404 Pull alternator back by hand to tighten belt. Using pry bar between alternator and engine, pull back alternator until belt is taut.
(CAUTION: Place pry tool so alternator will not be damaged.)

7.0405 When tension is satisfactory, tighten alternator adjusting arm bracket belts. (Press belt with finger and if give is about ½ inch, belt tension is satisfactory.)

7.0406 Check tension.

PERFORMANCE STANDARDS:

- Inspect, adjust, and replace charging (alternator) system belt so there is proper tension on the belt.
- Damaged or worn belt should be replaced upon completion, the belt condition will be checked for servicability, tension checked, and all bolts checked for security.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL I

TASK 7.05 TEST, SERVICE, OR REPLACE BATTERIES,
CABLES, AND BATTERY BOXES

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## PERFORMANCE OBJECTIVE:

Given an automobile and battery requiring servicing or checking; provide maintenance for the battery and associated holder/case; check the battery cell electrolyte level, test the specific gravity of the battery, test the battery voltage, and charge a battery. Performance must be to manufacturer's specifications and to instructor's standards.

## PERFORMANCE ACTIONS:

7.0501 Remove a battery in need of service and clean the battery terminals, cables, carrier, hold-down ends, and replace the battery in the vehicle in accordance with given instructions.

7.0502 Check the battery cell electrolyte level and fill the cells with water to a specified level, being careful not to overfill.

7.0503 Test the specific gravity using a hydrometer to determine the amount of charge.

7.0504 Test battery voltage under high load using a voltmeter in accordance with given specifications.

7.0505 Recharge a battery using a portable charger in accordance with the manufacturer's specifications.

7.0506 Replace the serviced battery, or a new battery in the automobile and crank test the system.

## PERFORMANCE STANDARDS:

- Provide maintenance, check battery cell electrolyte level, test the specific gravity of the battery, test the battery voltage, and recharge a given battery or batteries.
- Meet manufacturer's specifications and instructor's standards.

SUGGESTED INSTRUCTION TIME: 6 Hours

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL I

TASK 7.06 PERFORM OPERATIONAL INSPECTION OF
LIGHTING SYSTEMS: REPLACE BULBS,
FLASHERS, AND FUSES AS NECESSARY

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PERFORMANCE OBJECTIVE:

Given a vehicle and service manual, check the operation of all exterior lights and control switches and determine if they are operating in accordance with the manufacturer's standards. Replace bulbs, flashers, and fuses as necessary.

PERFORMANCE ACTIONS:

7.0601 Visually inspect the operation of the following lights:
- a. Parking lights
- b. Head lamps (high and low beams)
- c. Tail
- d. Turn signals
- e. Brakes
- f. Marker
- g. Clearance
- h. Backup
- i. License plate

7.0602
- a. Replace bulbs that are burned out.
- b. Replace flashers that are inoperative.
- c. Replace blown fuses.

7.0603 Test the operation of all exterior lighting control switches.

7.0604 List any lighting circuit that is not operating in accordance with the manufacturer's standards.

PERFORMANCE STANDARDS:

- Perform an operational inspection of all exterior lights and control switches on the automobile provided by the instructor, and identify those that are malfunctioning.
- Replace bulbs, flashers, and fuses that are faulty.

SUGGESTED INSTRUCTION TIME: 1 Hour

RELATED TECHNICAL INFORMATION:

- Inspection of fuses.

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL I

TASK 7.07 TEST AND REPLACE FUSES

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PERFORMANCE OBJECTIVE:

On a given automobile, test and replace fuses using the manufacturer's specifications (owner's manual, or other data), instructor provided parts, tools, and equipment.

PERFORMANCE ACTIONS:

7.0701 Locate the fuse block or fuse in question.

7.0702 Replace defective fuses found by inspection or by testing the fuse with a ohmmeter or test lamp.

7.0703 Insert the replacement or good fuse in the hold properly so a good electrical connection is made. No damage should result to the fuse or holder.

(NOTE: Replacement fuses should be of the proper type and amperage and meet manufacturer's specifications.)

PERFORMANCE STANDARDS:

- Test and replace defective fuses in a given automobile following manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 1 Hour

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL I

TASK 7.08 REPLACE FLASHER UNITS

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PERFORMANCE OBJECTIVE:

Given a defective flasher unit in an automobile, and using the required tools and service manual; replace the flasher unit in accordance with manufacturer's specifications.

PERFORMANCE ACTIONS:

7.0801 Locate flasher unit.

7.0802 Remove unit from socket (holder).

7.0803 Install new unit making sure it is properly inserted in the holder (socket).

7.0804 Make operational check for proper functioning.

PERFORMANCE STANDARDS:

- Replace the flasher unit in an automobile provided by the instructor.

SUGGESTED INSTRUCTION TIME: 1 Hour

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL I

TASK 7.09 ADJUST BACKUP LIGHT SWITCHES

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PERFORMANCE OBJECTIVE:

Given a vehicle with an incorrectly adjusted backup light switch, and the necessary hand tools, and service manual; adjust the switch to a working order which meets manufacturer's specifications.

PERFORMANCE ACTIONS:

7.0901 Locate the backup light switch (steering column or transmission linkage).

7.0902 Place shift level in reverse.

7.0903 Loosen the securing screws and adjust the switch until the backup lights come on and retighten the screws.

7.0904 Run the shift level through all positions, checking to see that the lights do not turn on except in reverse.

PERFORMANCE STANDARDS:

- On an automobile with incorrectly adjusted backup light switches, adjust the switches to a working order which meets the manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 1 Hour

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL I

TASK 7.10 ADJUST HEADLIGHTS

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PERFORMANCE OBJECTIVE:

Given an automobile and headlight tester, adjust the automobile headlights to meet state requirements using the Headlight Tester in accordance with given procedures.

PERFORMANCE ACTIONS:

7.1001 Place vehicle on level surface with wheels straight ahead.

7.1002 Remove retainer ring(s) from headlight beam(s) and secure safely.

7.1003 Adjust high and low beam of headlights in accordance with SC State requirements and manufacturer's specifications.

7.1004 Replace retainer ring(s) on headlight beam(s) and secure in safe manner.

PERFORMANCE STANDARDS:

- Adjust the headlights of an automobile provided by the instructor so the adjustments meet state requirements and manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 1 Hour

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL II

TASK 7.11 SET IGNITION TIMING

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PERFORMANCE OBJECTIVE:

Given an operational engine, service manual, and access to the necessary tools and equipment: set the ignition timing in accordance with the manufacturer's specifications. Timing must be within +/- 1 degree of manufacturer's specifications.

PERFORMANCE ACTIONS:

7.1101 Refer to manufacturer's manual for proper specifications and procedure.

7.1102 Connect timing light in circuit.

7.1103 Loosen distributor bolts.

7.1104 Start engine and operate as specified idle.

7.1105 Turn distributor to obtain desired timing setting.

7.1106 Reset idle, as necessary, to proper specifications.

PERFORMANCE STANDARDS:

- Provided an operational vehicle, set the ignition timing within +/- 1 degree of the manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 2 Hours

RELATED TECHNICAL INFORMATION:

- Timing light should "freeze" timing mark. There should be no shift in timing.
- Difference in timing between No. 1 cylinder and the alternate firing cylinder should be 3-degrees or less.

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL II

TASK 7.12 REPLACE ALTERNATORS

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PERFORMANCE OBJECTIVE:

Given necessary tools, equipment, and service manual; install an alternator on a vehicle provided by the instructor meeting the manufacturer's specifications. Upon completion, the alternator will operate without noise or shimmying.

PERFORMANCE ACTIONS:

7.1201 Check regular performance before installing alternator or generator.

7.1202 Disconnect battery cables from battery terminals.

7.1203 Disconnect and identify wire leads from alternator or generator.

7.1204 Remove alternator brace bolt, then remove belt or belts.

7.1205 Remove alternator pivot attaching bolt and remove alternator from vehicle.

7.1206 Install replacement generator or alternator by reversing the procedures.

7.1207 Adjust belt tension to manufacturer's specifications.

7.1208 Start engine and check performance.

PERFORMANCE STANDARDS:

- On an instructor provided vehicle with a defective alternator remove the old alternator and replace it with a new one.

SUGGESTED INSTRUCTION TIME: 3 Hours

RELATED TECHNICAL INFORMATION:

- Generator servicing.

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL II

TASK 7.13 REPLACE STARTERS

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PERFORMANCE OBJECTIVE:

Given access to the necessary tools and equipment, and a service manual; replace the starter on an assigned vehicle and make the required tests to determine if the operation is in accordance with the manufacturer's specifications.

PERFORMANCE ACTIONS:

7.1301 Remove negative (-) battery cable from battery terminal.

7.1302 Disconnect all wires at the starter.

7.1303 Disconnect any mechanical linkage that has been removed.

7.1304 Remove bolts holding starter to engine.

7.1305 Remove starter.

7.1306 Replace the starter by reversing the process of disassembly.

7.1307 Replace mounting bolts.

7.1308 Replace any mechanical linkage.

7.1309 Connect all wires at the starter.

7.1310 Connect negative (-) battery terminal.

7.1311 Perform starter draw test in accordance with manufacturer's specifications.

PERFORMANCE STANDARDS:

- Given a starting motor in need of replacement, remove and replace it according to manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 6 Hours

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL II

TASK 7.14 REPLACE STARTER SOLENOID

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PERFORMANCE OBJECTIVE:

Provided the necessary tools, equipment, service manual and a vehicle with a defective solenoid, replace the solenoid in accordance with manufacturer's specifications.

PERFORMANCE ACTIONS:

7.1401 Remove the negative (-) battery cable from the battery post.

7.1402 Remove wires from solenoid and identify for future installation hook up.

7.1403 Visually check terminal connections for breaks, corrosion, etc., which would keep solenoid from energizing.

7.1404 Remove starter solenoid in accordance with manufacturer's specifications.

7.1405 Install new starter solenoid in accordance with manufacturer's specifications.

7.1406 Install negative (-) battery cable to battery post.

7.1407 System check starter solenoid in accordance with manufacturer's specifications.

PERFORMANCE STANDARDS:

- Remove the defective solenoid in the vehicle provided by the instructor and replace it with a new one.

SUGGESTED INSTRUCTION TIME: 7 Hours

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL II

TASK 7.15 REPAIR ALTERNATORS

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PERFORMANCE OBJECTIVE:

Given a malfunctioning repairable generator, the proper tools and equipment, and service manual; complete the necessary repairs on the alternator. Identification of the problem(s) must conform to the instructor's diagnosis, and repairs must be within the manufacturer's specifications.

PERFORMANCE ACTIONS:

7.1501 Remove negative (-) battery cable.

7.1502 Remove alternator from vehicle.

7.1503 Remove case frame bolts (4 typical). (Scribe alternator to allow exact reassembly.)

7.1504 Separate drive end frame and rotor from stator assembly by prying with screwdriver lightly.

7.1505 Place tape over slip ring or brush end frame bearing to seal it from dirt.

7.1506 Lightly clamp rotor in vise to remove shaft nut. Be sure not to overtighten vise and damage rotor.

7.1507 Remove nut from rotor shaft, take off washer, pulley, fan, and colar or spacer.

7.1508 Separate drive end frame from rotor shaft.

7.1509 Remove three stator leads attaching nuts and separate stator from end frame.

7.1510 Remove screws, brushes, and holder assembly.

7.1511 Remove battery, ground, and attaching screw terminals, then remove heat sink, as applicable.
(NOTE: All diodes are marked with either a (+) or (-) on the case or are marked with red paint for (+) coils, or black paint for (-) diodes to identify the polarity of the case.)

7.1512 Negative ground system: The negative diodes are mounted into the slip ring end frame, the positive diodes are mounted into the insulated heat sink.

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL II

TASK 7.15 REPAIR ALTERNATORS (Con't.)

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PERFORMANCE ACTIONS (Con't.):

7.1513 Test diodes and replace them as necessary.

7.1514 Test rotor for grounded, open, or shorted field coils.

7.1515 Check stator windings for grounded, open, or shorted windings.

7.1516 Check slip rings if they are rough or out of round, replace as necessary.

7.1517 Check brushes and replace as necessary.

7.1518 Reassemble alternator using the reverse steps to disassembly.

7.1519 Test the vehicle charging system.

PERFORMANCE STANDARDS:

- On an instructor provided vehicle, repair a given alternator to manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 8 Hours

RELATED TECHNICAL INFORMATION:

- GENERATION REPAIR:
    1. Remove generator adjustment brace, remove belt, and mounting bolts, remove battery cable, and wires from generator field, armature, and ground.
    2. Remove two bolts from brush hold or end plate.
    3. Check end plate brushing, drive and busing or bearings, and brushes, replacing them as necessary.
    4. Check armature, and fields for ground, open, shorted circuits.
    5. Check commutator end of armature condition, and turn and undercut commutator if necessary.
    6. Replace all parts necessary to make generator operate within manufacturer's specifications.
    7. Assemble generator using reverse steps to disassembly.
    8. Test for proper operation of generator.

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|---|---|---|
| UNIT | 7.0 | ELECTRICAL AND IGNITION SYSTEMS<br>LEVEL II |
| TASK | 7.16 | ANALYZE MALFUNCTIONS IN THE CRANKING SYSTEM |

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PERFORMANCE OBJECTIVE:

Given a vehicle with a malfunction in the cranking circuit, a service manual, and access to the necessary test equipment and hand tools; isolate the malfunction and estimate the required repair needed to meet the manufacturer's specifications. Identification of the problem and the repair needed to correct it must be the same as the instructor's findings.

PERFORMANCE ACTIONS:

7.1601 Refer to vehicle manufacturer's service information to determine testing procedures.

7.1602 Refer to test equipment's manufacturer operating instructions.

7.1603 Perform the following tests:
a. Battery Capacity Test
b. Starter Draw Test
c. Voltage Drop Test
d. Starter Control Circuits Test

7.1604 List components or service required to repair the vehicle in accordance with manufacturer's specifications.

PERFORMANCE STANDARDS:

- Identify the problem and the repair needed to correct a malfunction in the cranking circuit of an instructor provided vehicle.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS LEVEL II

TASK 7.17 REPLACE AND ADJUST DISTRIBUTORS

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## PERFORMANCE OBJECTIVE:

Using required equipment, tools, and ignition distributor; replace the distributor on an operational engine in accordance with the manufacturer's specifications.

## PERFORMANCE ACTIONS:

7.1701 Refer to manufacturer's service manual for procedures and specifications.

7.1702 Remove coil wire from top of distributor and ground it to engine block.

7.1703 Crank engine until number one cylinder is top dead center on the compression stroke.

7.1704 Install distributor with rotor pointing toward number one cylinder on distributor.

7.1705 Replace hold down plate and screw.

7.1706 Replace rotor and distributor cap.

7.1707 Place wires in distributor cap according to firing order of vehicle; see manufacturer's specifications.

7.1708 Start engine.

7.1709 Set engine RPM, ignition timing, dwell degree angle, reset RPM, and check engine performance.

## PERFORMANCE STANDARDS:

- Replace the distributor and set the timing to meet manufacturer's specifications on an instructor provided engine requiring distributor replacement.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL II

TASK 7.18 REPAIR OR REPLACE SWITCHES

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PERFORMANCE OBJECTIVE:

Given an automobile with various types of electrical switches of which some are known to be defective, the necessary test equipment and a service manual; identify the defective switches and replace them as necessary.

PERFORMANCE ACTIONS:

7.1801 Using an ohmmeter or continuity light, check the switch terminals in each position.

7.1802 Identify defective switches.

7.1803 Make appropriate repairs or replacements while referring to the manufacturer's service manual.

7.1804 Test switches for proper functioning after the replacements and repairs have been made.

PERFORMANCE STANDARDS:

- Identify defective switches on an automobile provided by the instructor and repair or replace the switches to restore proper working operation. Observe the proper current rating of replacement switches.

SUGGESTED INSTRUCTION TIME: 2 Hours*

*Depends on type and location of switch.

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL II

TASK 7.19 REPAIR WINDSHIELD WIPER
MECHANISMS AND CONTROLS

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PERFORMANCE OBJECTIVE:

Using the required tools, service manual, and an automobile with malfunctioning windshield wiper mechanisms and controls; repair all malfunctions in accordance with manufacturer's specifications. Upon completion, the wipers must operate as prescribed in the manufacturer's operating instructions.

PERFORMANCE ACTIONS:

7.1901 Check dash control level or button for shorts or poor contact points.

7.1902 Check dash control to determine if lever is sticking or too loose.

7.1903 Check electrical wiper motor for defects.

7.1904 Check for problems in linkage, drive crank, or pivot.

7.1905 Check reduction gears for wear.

7.1906 Repair or replace malfunctioning components.

7.1907 Operation test the wipers and controls for proper functioning.

PERFORMANCE STANDARDS:

- On an instructor provided automobile with malfunctioning windshield wiper mechanisms and controls, locate the malfunctions and make the necessary repairs to restore the wipers to proper working order.

SUGGESTED INSTRUCTION TIME: 4 Hours*

*Depends on make and type unit.

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL II

TASK 7.20 REPAIR OR REPLACE FUSE BOX ASSEMBLY

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## PERFORMANCE OBJECTIVE:

Provided a vehicle with a malfunction in the fuse block, the necessary tools and equipment, and a service manual; repair or replace the fuse block as is required in the manufacturer's specifications.

## PERFORMANCE ACTIONS:

7.2001 Disconnect negative (-) battery cable from battery.

7.2002 Disconnect fuse block from automobile.

7.2003 Disconnect wire leads from fuse block.

7.2004 Determine cause of problem in fuse block.

7.2005 Repair the fuse block, or replace it if necessary.

7.2006 Reconnect wire leads to fuse block and attach the block to automobile.

7.2007 Reconnect battery cables.

7.2008 Test fuse block for proper functioning.

## PERFORMANCE STANDARDS:

- Repair or replace fuse block on instructor provided automobile with a malfunction in fuse block.

SUGGESTED INSTRUCTION TIME: 2 Hours

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|---|---|---|
| UNIT | 7.0 | ELECTRICAL AND IGNITION SYSTEMS<br>LEVEL II |
| TASK | 7.21 | REPLACE CHASSIS AND UNDERHOOD WIRING |

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PERFORMANCE OBJECTIVE:

Given access to the required tools, equipment, service manual, wiring harness and an automobile; replace the chassis and underhood wiring in accordance with manufacturer's procedures. All replacements must conform to specifications set forth in the vehicle's service manual.

PERFORMANCE ACTIONS:

7.2101 Locate manufacturer's service procedures.

7.2102 Remove designated wiring harness.

7.2103 Install given wiring harness.

7.2104 Operational test replaced harness.

PERFORMANCE STANDARDS:

- Replace chassis and underhood wiring in a vehicle provided by the instructor.

SUGGESTED INSTRUCTION TIME: Depends on type of vehicle and degree of rewiring necessary. (Typically, competency not developed.)

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL III

TASK 7.22 TEST AND REWIRE DASH UNITS

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PERFORMANCE OBJECTIVE:

Given a vehicle with a known malfunction in the dash unit, the proper tools and equipment, and service manual; locate the malfunction and make the required repairs in accordance with manufacturer's specifications.

PERFORMANCE ACTIONS:

7.2201 Determine which dash unit is defective.

7.2202 Refer to manufacturer's manual on replacement of defective unit.

7.2203 Remove defective unit.

7.2204 Repair unit if applicable.

7.2205 Install unit.

7.2206 Perform operational check.

PERFORMANCE STANDARDS:

- Locate malfunction and make required repairs on instructor provided automobile with malfunction in the dash unit.

SUGGESTED INSTRUCTION TIME: Depends on make of vehicle and type of wiring. (Typically, competency not developed.)

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS LEVEL III

TASK 7.23 ANALYZE CAUSE OF ELECTRICAL MALFUNCTION

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PERFORMANCE OBJECTIVE:

Given a vehicle with a defective electrical circuit and a service manual, determine the cause of the problem and estimate the required repairs in accordance with the manufacturer's specifications. The cause and the required repairs identified must agree with the instructor's findings.

PERFORMANCE ACTIONS:

7.2301 Determine the circuit or circuits involved.

7.2302 Check all fuses in fuse block.

7.2303 Refer to overhaul manual on prescribed vehicle wiring schematic.

7.2304 Consult the flat rate manual on electrical circuit as to allocated time.

7.2305 Determine the components and wiring which are damaged.

PERFORMANCE STANDARDS:

- On an instructor provided vehicle with evidence of an electrical malfunction, determine the cause of the problem and identify all necessary repairs.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL III

TASK 7.24 REPLACE IGNITION SWITCH AND RESISTOR

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PERFORMANCE OBJECTIVE:

Given access to required tools, ignition switch, ignition resistor, and an operational automobile; replace the ignition switch and resistor in accordance with the manufacturer's specifications. The automobile ignition system must meet the manufacturer's service manual.

PERFORMANCE ACTIONS:

7.2401 Locate ignition switch.

7.2402 Refer to manufacturer's manual on step-by-step procedure for removing and installing switch.

7.2403 Remove ignition switch.

7.2404 Install new ignition switch.

7.2405 Make operational check.

7.2406 Locate ignition resistor.

7.2407 Refer to manufacturer's manual step-by-step procedure for removing and replacing resistor.

7.2408 Remove the ignition resistor (wire on ballast).

7.2409 Install new ignition resistor.

7.2410 Perform operational check.

PERFORMANCE STANDARDS:

- Replace the ignition switch and resistor in the automobile provided by the instructor.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS LEVEL III

TASK 7.25 EVALUATE ALTERNATOR AND REGULATOR OUTPUT

---

PERFORMANCE OBJECTIVE:

Given necessary diagnostic test equipment, tools and specification manual, test charging circuit on a given automobile to determine if its performance is in accordance with manufacturer's specifications.

PERFORMANCE ACTIONS:

7.2501 Refer to vehicle manufacturer service information to determine specifications for the charging circuit.

7.2502 Refer to test equipment's manufacturer operating instructions to determine testing procedures.

7.2503 Perform the following tests:
a. Output Test.
b. Voltage Regulator Test.
c. Current Regulator Test, if appropriate.
d. Charging Circuit Voltage Drop Test.

PERFORMANCE STANDARDS:

- Test the charging circuit in the automobile provided by the instructor and evaluate the alternator and regulator output.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS LEVEL III

TASK 7.26 REPAIR OR REPLACE CHARGING SYSTEM REGULATOR

---

PERFORMANCE OBJECTIVE:

Given a vehicle with trouble in the voltage regulator, the necessary test equipment and tools, and a service manual; locate the problem and repair or replace the component(s) as required by manufacturer's specifications.

PERFORMANCE ACTIONS:

7.2601 Disconnect ground cable at battery.

7.2602 Disconnect the wiring harness from regulator.

7.2603 Remove mounting screws and remove the regulator.

7.2604 Make sure that regulator base gasket is in place before installation.

7.2605 Check regulator and make necessary adjustments if possible, if not replace with a new regulator.

7.2606 Make sure mounting screws are not over-tightened and avoid damaging bushing on base or mounting screws.

7.2607 Replace regulator by reversing the disassembly procesures.

PERFORMANCE STANDARDS:

- On an instructor provided automobile with trouble in the voltage regulator, locate the malfunction and make the appropriate repairs or replacements.

SUGGESTED INSTRUCTION TIME: 8 Hours*

*Times vary for internal and external regulators.

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL III

TASK 7.27 ANALYZE OR ADJUST ENGINE PERFORMANCE
USING ENGINE ANALYZER

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## PERFORMANCE OBJECTIVE:

Assigned an engine analyzer, vehicle, service manual, and the necessary tools; test and perform minor adjustments as required on an assigned vehicle in accordance with the manufacturer's specifications. All adjustments identified by the instructor must be recognized and performed.

## PERFORMANCE ACTIONS:

7.2701 Refer to vehicle manufacturer's service information to determine procedure and specifications on the following:

- a. Curb idle adjustment +/- 50 RPM
- b. Air-fuel mixture adjustment
- c. Dwell adjustment +/- 2 degrees
- d. Ignition timing adjustment +/- 1 degree

7.2702 Refer to engine analyzer manufacturer's operating instructions to determine analyzer testing procedure.

7.2703 Perform testing procedure to determine required adjustments.

7.2704 Perform all required minor adjustments in accordance with manufacturer's procedure and specifications.

## PERFORMANCE STANDARDS:

- Using an engine analyzer, analyze and adjust as appropriate an automobile engine provided by the instructor. All adjustments identified by the instructor must be recognized and performed meeting manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 3 Hours

## RELATED TECHNICAL INFORMATION:

- Describe the use of the oscilloscope in diagnosing ignition system problems.
- Interpret standard oscilloscope patterns necessary for entry level service work in a dealer service department.

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL III

TASK 7.28 STROBE DISTRIBUTOR AND MODIFY/
CORRECT ADVANCE CURVES

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## PERFORMANCE OBJECTIVE:

Given a distributor, necessary equipment, and required tools; place distributor in machine and check timing and dwell angle and make adjustments in accordance with the manufacturer's specifications.

## PERFORMANCE ACTIONS:

7.2801 Place distributor in machine.

7.2802 Check advance spring tension.

7.2803 Check points spring for correct tension.

7.2804 Check distributor shaft busing for wear.

7.2805 Set dwell angle and points for cam bounce.

7.2806 If distributor machine is not available, place the distributor in a live engine and check advance and points spring tension, making adjustments as necessary.

7.2807 Disconnect the distributor vacuum advance hose from the distributor and plug hose.

7.2808 Locate timing marks at front of engine on the harmonic balancer.

7.2809 Put small amount of white paint or chalk on correct marks so they are more visible.

7.2810 Connect timing light to number one cylinder.

7.2811 Loosen the distributor hold-down screw.

7.2812 Start the engine and rotate the distributor until correct marks line up.

7.2813 Tighten the distributor hold-down screw and recheck timing.

---

PERFORMANCE ACTIONS (Con't.):

7.2814 Reconnect vacuum hose and check performance of engine.
(NOTE: If engine knocks due to gasoline quality, bump timing down slightly, preferably during road test /⎡testing under load_7 ).

PERFORMANCE STANDARDS:

- On an instructor provided distributor requiring operational adjustment, place the distributor machine (if available) and check the timing and dwell angle and make the necessary adjustments to meet the manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 8 Hours

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL III

TASK 7.29 INSPECT SECONDARY CIRCUIT LEAD WIRES, DISTRIBUTOR CAP, AND ROTOR, AND MEASURE SECONDARY WIRE RESISTANCE

---

PERFORMANCE OBJECTIVE:

Given an automobile, visually inspect the secondary wires, distributor cap and rotor. Make an ohmmeter check to determine if replacement is necessary to meet manufacturer's specifications. All defects identified by the instructor must be identified.

PERFORMANCE ACTIONS:

7.2901 Refer to vehicle manufacturer's service information to determine checking procedure and specifications.

7.2902 Visually check the condition of the distributor cap and rotor.

7.2903 Test the secondary wires for the proper resistance value.

7.2904 List components that require placement.

PERFORMANCE STANDARDS:

- On an instructor provided vehicle with an electrical problem in the secondary circuit, make an ohmmeter check and visual inspection of the circuit and identify the malfunctions to the instructor.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL III

TASK 7.30 INSPECT IGNITION SWITCH, RESISTOR, WIRING, AND COIL OF THE PRIMARY CIRCUIT

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PERFORMANCE OBJECTIVE:

Given the necessary test equipment and the components of a primary circuit (ignition switch, resistor, wiring, and coil), visually inspect and make tests to determine if each unit meets the manufacturer's specifications. Any malfunctions identified by the instructor must be recognized.

PERFORMANCE ACTIONS:

7.3001 Refer to the vehicle manufacturer's service information to determine checking procedure and specifications for the primary ignition circuit components.

7.3002 Test the following components.
a. Ignition switch.
b. Ignition resistor.
c. Ignition primary circuit wiring.
d. Ignition coil.
e. Ignition by-pass circuit.

7.3003 List each defective component.

PERFORMANCE STANDARDS:

- Inspect and test the ignition switch, resistor, wiring and coil of a given primary circuit and identify any malfunctions that exist.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL III

TASK 7.31 REPLACE COIL OF THE PRIMARY CIRCUIT

---

PERFORMANCE OBJECTIVE:

Provided with a new ignition coil, access to necessary tools, and an operational engine; replace the ignition coil in accordance with the manufacturer's service procedures. The new coil must be operational and meet the specifications set forth in the manufacturer's service manual.

PERFORMANCE ACTIONS:

| | |
|---|---|
| 7.3101 | Remove any items that prevent access to the coil. |
| 7.3102 | Remove the primary and secondary wires from the coil. |
| 7.3103 | Remove securing bolts and coil. |
| 7.3104 | Reinstall by reversing the disassembly procedures. |
| 7.3105 | Perform operational test of the ignition system. |

PERFORMANCE STANDARDS:

- The instructor will provide a vehicle requiring a new ignition coil.
- Replace the coil and perform an operational test for proper functioning.

SUGGESTED INSTRUCTION TIME: 2 Hours*

*Different procedures used for GM-HEI system.

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS LEVEL III

TASK 7.32 LOCATE AND REPAIR SHORTS AND OPEN CIRCUITS IN WIRING

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PERFORMANCE OBJECTIVE:

Given a vehicle with a shorted wire or open circuit, the necessary tools and test equipment, and a service manual; locate and repair the short or open circuit to meet the manufacturer's specifications.

PERFORMANCE ACTIONS:

7.3201 Locate the defective circuit.

7.3202 Refer to vehicle manufacturer's service information to determine specifications.

7.3203 Using proper tests determine reason for malfunction.

7.3204 Repair defective circuit.

7.3205 Test circuit for proper operation in accordance with manufacturer's specifications.

PERFORMANCE STANDARDS:

- On an instructor provided automobile with a known short or open circuit in the wiring, locate the short and make the necessary repairs.

SUGGESTED INSTRUCTION TIME: Depends on electrical problem encountered.

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEM
LEVEL III

TASK 7.33 TEST AND REPAIR ELECTRONIC IGNITION
SYSTEMS

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PERFORMANCE OBJECTIVE:

Given a vehicle with a malfunction in the electronic ignition, and the proper test equipment and tools; isolate the malfunction and repair or replace components as required, in accordance with the manufacturer's specifications.

PERFORMANCE ACTIONS:

7.3301 Disconnect the distributor leads from the engine wiring harness.

7.3302 Connect the two leads of an ohmmeter to the distributor leads at the connector.

7.3303 Rotate the magnetic pickup assembly in the distributor through the vacuum advance travel and read the ohmmeter.

7.3304 Ohmmeter reading should be within a range of 500-700 ohms; if not in this range replace the magnetic pickup assembly.

7.3305 If reading is within 500-600 ohms range, disconnect one ohmmeter lead from the distributor connect or connect it to a good ground.

7.3306 If ohmmeter needle moves to end of scale (0 ohms), replace the magnetic pickup assembly.

7.3307 If needle does not indicate short, and there was no spark when the spark plug wire was disconnected from the plug, the module is bad.

7.3308 Replace module, as necessary.

PERFORMANCE STANDARDS:

- Isolate the malfunction and repair or replace the components of an electronic ignition system on an instructor provided vehicle.

SUGGESTED INSTRUCTION TIME: 4 Hours

| | | |
|---|---|---|
| UNIT | 7.0 | ELECTRICAL AND IGNITION SYSTEMS<br>LEVEL III |
| TASK | 7.34 | INSPECT POINTS AND CONDENSER<br>OF PRIMARY CIRCUIT |

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## PERFORMANCE OBJECTIVE:

Given a distributor, inspect the contact points and the condenser using an ohmmeter and determine if replacement is required to meet the manufacturer's specifications. The task should be accomplished satisfactorily.

## PERFORMANCE ACTIONS:

7.3401 Refer to vehicle manufacturer's service information to determine checking procedures and specifications.

7.3402 Visually inspect the ignition points for:
  a. Condition of contact point surface.
  b. Alignment of the contact points.
  c. Spring tension.

7.3403 Perform any additional checking recommended by the manufacturer.

7.3404 List any defects found.

## PERFORMANCE STANDARDS:

- Inspect the contact points and condenser of a distributor provided by the instructor to determine if replacement is required to meet operational specifications.

SUGGESTED INSTRUCTION TIME: 1 Hour

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS LEVEL III

TASK 7.35 REPLACE POINTS AND CONDENSER (Tune-up)

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PERFORMANCE OBJECTIVE:

Given access to the required tools, equipment, ignition points, condenser and an operational engine; replace the ignition points and condenser in accordance with the manufacturer's specifications. The degrees of dwell must be within 2 degrees of the manufacturer's specifications.

PERFORMANCE ACTIONS:

7.3501 Remove the distributor cap.

7.3502 Loosen the lead screw and detach the leads.

7.3503 Loosen the two screws holding the contact set to the breaker plate.

7.3504 Slip the contact set out from under the screws.

7.3505 Wipe the breaker plate clean and oil the lever post, if applicable.

7.3506 Install new contacts, attach leads, and adjust the point opening, making sure the contacts are properly aligned.

7.3507 Tighten all screws and recheck the point opening.

7.3508 Lubricate the distributor as specified, and reassemble the distributor cap to its base.

7.3509 Turn engine on to performance test the points and condenser.

PERFORMANCE STANDARDS:

- Replace the ignition points and condenser on an automobile provided by the instructor so that they meet the manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEM
LEVEL III

TASK 7.36 OVERHAUL DISTRIBUTOR*

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## PERFORMANCE OBJECTIVE:

Given a malfunctioning distributor and the necessary tools and equipment, overhaul the distributor and calibrate in accordance with the manufacturer's specifications. The degree of dwell must be within +/- 2 degrees of the manufacturer's specifications.

## PERFORMANCE ACTIONS:

7.3601 After the cap, rotor, and dust seal are off, disassemble the terminal and take out the braker plate.

7.3602 Remove the coupling or gear by grinding or filing off the peened-over head of the pin and driving out the pin.

7.3603 Lift the shaft and advance mechanism assembly out of the distributor housing.

7.3604 Disassembly advance mechanism, noting the condition of the bearing in the distributor housing.

7.3605 Repair or replace worn or defective parts as necessary. **

7.3606 Reassemble distributor, making sure shaft and end play is correct when installing the gear on coupling.

7.3607 Make adjustments to contact points and advances.

7.3608 Lubricate the distributor before reinstalling.

7.3609 Install distributor and performance test the mechanism.

## PERFORMANCE STANDARDS:

- On an instructor provided distributor that has malfunctioned but is repairable, overhaul the distributor, calibrate it to the manufacturer's specifications, install it, and test the operation.

SUGGESTED INSTRUCTION TIME: 4 Hours

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*Typically, necessary for replacement of GM magnetic pickup.
**Typically, bushings are not replaced.

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL III

TASK 7.37 PERFORM COMPLETE ENGINE TUNE-UP

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PERFORMANCE OBJECTIVE:

Given an automobile needing a complete engine tune-up, the necessary specifications, tools and diagnostic equipment, and repair or replacement parts; perform a complete engine tune-up so that the automobile operates to manufacturer's specifications and to the standards of the instructor (service foreman).

PERFORMANCE ACTIONS:

7.3701 Service the battery.

7.3702 Service the crankcase emission control system.

7.3703 Service and test the carburetor air cleaner, lubricate the manifold heat control valve.

7.3704 Service drive belts.

7.3705 Test compression.

7.3706 Service spark plugs.

7.3707 Service the distributor and coil.

7.3708 Service spark-plug cables.

7.3709 Set dwell and ignition timing.

7.3710 Replace fuel filter.

7.3711 Service automatic choke.

7.3712 Make carburetor adjustments.

7.3713 Service the fuel-evaporation emission control system.

7.3714 Service the A.I.R. system, if applicable.

7.3715 Service the EGR system, if applicable.

7.3716 Road-test the automobile to ensure that it operates properly.

UNIT 7.0 ELECTRICAL AND IGNITION SYSTEMS
LEVEL III

TASK 7.37 PERFORM COMPLETE ENGINE TUNE-UP
(Con't.)

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PERFORMANCE STANDARDS:

- Perform a complete engine tune-up according to manufacturer's shop manual or specification.
- The above steps should provide a minimum outline of items to be checked.
- Meet the instructor's standards for tune-up.

SUGGESTED INTRUCTION TIME: 8 Hours

RELATED TECHNICAL INFORMATION:

- Diagnostic test equipment.
- Engine specifications.

## TASK LISTINGS
## AUTOMOTIVE MECHANICS

| UNIT/TASK | DESCRIPTION |
|---|---|
| Unit 8.0 A | DRIVE TRAIN |
| 8.01 | (Check Fluid Levels in Standard Transmission) Given an automobile with a standard transmission, check the lubricant level and fill it to the specified level with a lubricant recommended by the manufacturer. |
| 8.02 | (Check Fluid Levels in Automatic Transmission and Fill to Proper Level) Given an automobile with an automatic transmission, check the automatic transmission fluid level and add the specified fluid as indicated on the gauge rod until the indicator shows full in accordance with given procedures. |
| 8.03 | (Select Fluids for Proper Application [Lubricate]) Given an automobile to lubricate the drive train, select the proper lubricant for the job and according to manufacturer's specifications. |
| 8.04 | (Inspect Universal Joints for Wear or Damage) Provided with a driveline assembly with known defects, access to the proper tools, equipment, and service manual; inspect the drive shaft U-joints, and center bearings for malfunctions. All malfunctions identified by the instructor must be recognized. Upon completion, the drive shaft will operate without excessive noise and vibration and the U-joints will not leak. |
| 8.05 | (Lubricate U-joints) Given a vehicle requiring lubrication of U-joints, service data, necessary tools, equipment, and lubrication; lubricate U-joints as specified in service manual or information. |
| 8.06 | (Lubricate Speedometer Cable Drive Gear and Housing) Provided a vehicle and access to the proper hand tools, lubricant, and service manual; lubricate the speedometer cable under the instructor's supervision.<br>The cable must be free from noise and binding after lubrication. |

UNIT 8.0 A DRIVE TRAIN - LEVEL I

TASK 8.01 CHECK FLUID LEVELS IN STANDARD TRANSMISSION

---

## PERFORMANCE OBJECTIVE:

Given an automobile with a standard transmission, check the lubricant level and fill it to the specified level with a lubricant recommended by the manufacturer.

## PERFORMANCE ACTIONS:

8.0101 Place vehicle on lift, and raise it.

8.0102 Clean dirt and grease from around the filler plug. (Filler plug typically is on the side of the transmission.)

8.0103 Remove filler plug using the drain plug wrench.

8.0104 Check lubricant level by sticking a finger in the filler hole. (If the oil can be touched at the edge of the hole, it is full.)

8.0105 To fill, insert grease lube pump hose in filler hole.

8.0106 Pump gear lubricant into transmission until gear lubricant appears at filler hole.

8.0107 Remove hose and wipe end of hose and filler hole area.

8.0108 Replace filler plug in hole and tighten plug so it will not vibrate loose.

8.0109 Lower car and remove it from lift.

## PERFORMANCE STANDARDS:

- Check the lubricant level of a standard transmission and fill it to the specified level with a lubricant recommended by the manufacturer.

SUGGESTED INSTRUCTION TIME: 1 Hour

| | | |
|---|---|---|
| UNIT | 8.0 A | DRIVE TRAIN - LEVEL I |
| TASK | 8.02 | CHECK FLUID LEVELS IN AUTOMATIC TRANSMISSION AND FILL TO PROPER LEVEL |

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PERFORMANCE OBJECTIVE:

Given an automobile with an automatic transmission, check the automatic transmission fluid level and add the specified fluid as indicated on the gauge rod until the indicator shows full in accordance with given procedures.

PERFORMANCE ACTIONS:

8.0201 Set parking brake.

8.0202 Start engine and warm it to normal operating temperature, (equivalent to about 10 miles of driving).

8.0203 Place gear selector level in park (P) position (or as recommended by manufacturer).

8.0204 Remove transmission fluid gauge rod, wipe dry, and replace in tube.

8.0205 Remove the transmission fluid gauge rod and check the position of the oil on the gauge. (Generally the "Full" to "Low" range on the gauge is one pint of fluid.)
(NOTE: If fluid is over "Full" or color is other than normal, see instructor.)

8.0206 Wipe the filler tube area with shop cloth to prevent dirt from falling into the filler tube.

8.0207 Insert transmission funnel into filler tube.

8.0208 Fill transmission with fluid as required to bring oil mark to "Full" mark on gauge.

8.0209 Recheck fluid level, adding fluid as necessary.

8.0210 If fluid is above "Full" level, drain transmission to prevent aeration.

PERFORMANCE STANDARDS:

- Check the automatic transmission fluid for a given vehicle and add fluid as necessary to bring the oil up to "Full" mark on the gauge.

UNIT 8.0 A DRIVE TRAIN - LEVEL I

TASK 8.02 CHECK FLUID LEVELS IN AUTOMATIC TRANSMISSION AND FILL TO PROPER LEVEL (Con't.)

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PERFORMANCE STANDARDS (Con't.):

- Use a transmission fluid specified by the manufacturer.

SUGGESTED INSTRUCTION TIME: 1 Hour

RELATED TECHNICAL INFORMATION:

- Determine the proper transmission fluid for the automobile.
- Drain fluid if overfilled.
- Avoid transferring dirt to the interior of the transmission by the dipstick.
- Check for leaks.

| | | |
|---|---|---|
| UNIT | 8.0 A | DRIVE TRAIN - LEVEL I |
| TASK | 8.03 | SELECT FLUIDS FOR PROPER APPLICATION (LUBRICATE) |

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PERFORMANCE OBJECTIVE:

Given an automobile to lubricate the drive train, select the proper lubricant for the job and according to manufacturer's specifications.

PERFORMANCE ACTIONS:

8.0301 Identify major lubricants for automotive use:
- a. Multipurpose chassie grease--front suspension and steering linkage.
- b. Multipurpose gear lubricant--to replinish supply in standard differentials and manual transmissions.
- c. Positive-traction differential lubricant--for positive-traction rear end vehicles.
- d. Power-steering fluid.
- e. Automatic transmission fluid.
- f. All-purpose white grease--lubricates metal body points that slide or rub against other body points such as latches, hinges, etc.
- g. Engine oil--to lubricate points requiring penetration.
- h. Silicone spray lubricant--for use on rubber parts.
- i. Graphite spray--for door locks, etc.
- j. Manifold-heat control-valve lubricant.

8.0302 Demonstrate proper choice of lubricant for specific drive train lubrication needs.

PERFORMANCE STANDARDS:

- Select the proper lubricant to lubricate a given automobile drive train system according to the manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 3 Hours

RELATED TECHNICAL INFORMATION:

- Replacement of grease (Zerk) fittings.

UNIT 8.0 A DRIVE TRAIN - LEVEL I

TASK 8.04 INSPECT UNIVERSAL JOINTS FOR WEAR OR DAMAGE

---

PERFORMANCE OBJECTIVE:

Provided with a driveline assembly with known defects, access to the proper tools, equipment, and service manual; inspect the drive shaft, U-joints, and center bearings for malfunctions. All malfunctions identified by the instructor must be recognized. Upon completion, the drive shaft will operate without excessive noise and vibration and the U-joints will not leak.

PERFORMANCE ACTIONS:

8.0401 Raise the automobile. If not on lift, place safety jack stands under it.

8.0402 Make visual inspection of drive shaft and U-joints:
  a. Visually inspect drive shaft for blurriness.
  b. Make sure U-joints flange bolts are not loose.
  c. Examine drive shaft for physical damage. Look for rusty dry powder around U-joints and seals.
  d. Check for excessive play in U-joints.

8.0403 Remove drive shaft. (Mark it so it can be properly aligned during reinstallation.)

8.0404 Remove center bearing snap ring and bearing assembly.

8.0405 Check U-joints on drive shaft for wear, oil leakage, and excessive play.

8.0406 Clean and relubricate U-joints and center bearing with recommended lubricants.

8.0407 Replace U-joint and center bearing assembly, reconnect drive shaft.

PERFORMANCE STANDARDS:

- Inspect the drive shaft, U-joints, and center bearings of a given automobile and identify any malfunctions of the components.

SUGGESTED INSTRUCTION TIME: 6 Hours

RELATED TECHNICAL INFORMATION:

- Blurring-whipping of the drive shaft resulting from uneven movement.

UNIT 8.0 A DRIVE TRAIN - LEVEL I

TASK 8.05 LUBRICATE U-JOINTS

---

PERFORMANCE OBJECTIVE:

Given a vehicle requiring lubrication of U-joints, service data, necessary tools, equipment, and lubrication; lubricate U-joints as specified in service manual or information.

PERFORMANCE ACTIONS:

(SEE LUBRICATION SECTION)

PERFORMANCE STANDARDS:

- (SEE LUBRICATION SECTION)
- Lubricate U-joints per service data.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 8.0 A DRIVE TRAIN - LEVEL I

TASK 8.06 LUBRICATE SPEEDOMETER CABLE DRIVE GEAR AND HOUSING

---

PERFORMANCE OBJECTIVE:

Provided a vehicle and access to the proper hand tools, lubricant, and service manual; lubricate the speedometer cable under the instructor's supervision. The cable must be free from noise and binding after lubrication.

PERFORMANCE ACTIONS:

8.0601 Locate the manufacturer's information concerning speedometer lubrication.

8.0602 Determine cable routing and location of securing clips if so equipped.

8.0603 Remove speedometer cable and housing.

8.0604 Replace the speedometer cable if required.

8.0605 Check the speedometer cable and housing for knicks before installing.

8.0606 Check the speedometer head for possible binding problems.

8.0607 Reconnect the cable to the head and transmission and replace the securing clips.

8.0608 Read test to check speedometer operation.

PERFORMANCE STANDARDS:

- Lubricate the speedometer cable on a vehicle provided by the instructor.

SUGGESTED INSTRUCTION TIME: 2 Hours

RELATED TECHNICAL INFORMATION:

- Select correct lubricant for the job according to specifications.

## TASK LISTINGS
## AUTOMOTIVE MECHANICS

| UNIT/TASK | DESCRIPTION |
|---|---|
| Unit 8.0 B | DRIVE TRAIN WITH MANUAL TRANSMISSION MAINTENANCE AND REPAIR |
| 8.01 | (Adjust Clutch) On a given vehicle requiring a clutch adjustment, service data and necessary tools and equipment; check for proper adjustment of the clutch and make the necessary adjustments to meet service data specifications. |
| 8.02 | (Repair and Replace Slip-joints, U-joints) Given a vehicle requiring lubrication service to the universal joints, and access to the proper tools, equipment, and service manual; lubricate the universal joints following the manufacturer's recommeneded procedures and specifications. Upon completion, the U-joints will function without leaking around the seals. |
| 8.03 | (Repair, Replace, or Adjust Front Drive Axle Assemblies) Provided a vehicle with a malfunctioning front drive axle assembly, and access to the proper hand tools, equipment, and service manual; adjust or replace the front drive axle assembly in accordance with the manufacturer's specifications and procedures. |
| 8.04 | (Replace Manual Transmission Rear Seal, Gasket, and Bushing [in Car Repairs]) Provided a standard transmission, and access to the proper hand tools, equipment, and service manual; replace the rear seal and bushing following the manufacturer's recommended procedures. Upon completion, there will be no leaks or excessive noise in the repaired areas. |
| 8.05 | (Remove and Replace Clutch, Disc Pressure Plate, Release [Throwout] Bearing, Pilot Bearing [Bushing], and Adjust External Shaft Linkage on Manual Transmission) Given a vehicle with a faulty pilot bearing, clutch disc pressure plate or release bearing, and access to the proper tools, equipment, and service manual; replace the pilot bearing following the manufacturer's recommended procedures and specifications. |
| 8.06 | (Replace Transmission Mounts) Provided a vehicle with faulty transmission mounts, and access to the proper hand tools, equipment and service manual; replace the transmission mounts following the manufacturer's recommended procedures and specifications. Upon completion, the mounts will be secure so that no noise or shimmying in the transmission occurs. |

8.07 (Test Manual Transmission Operation) Given a vehicle with a malfunction in the manual transmission, and access to the proper tools, equipment, and service manual, check the transmission in all speeds and identify the problem(s). Problem identification must be the same as the instructor's.

8.08 (Replace Manual Transmission) Given a vehicle with a manual transmission, and access to the proper tools, equipment, and service manual; replace the transmission following the manufacturer's procedures and specifications. When completed, the transmission will not leak, shimmy, or contain problems in shifting.

8.09 (Rebuild Manual Transmission) Provided a standard transmission with know defects, and access to the proper hand tools, equipment, and service manual; disassemble and repair the defective components of the transmission, following the manufacturer's recommended procedures and specifications. All known defects in the transmission must be identified and repaired.

8.10 (Replace Rear Axle Shaft, Bearing, and Seal) Provided a vehicle, and access to the proper hand tools, equipment, and service manual; replace the rear axle shaft, bearings, and seal following the manufacturer's recommended procedures and specifications. Upon completion, there will be no leaks or excessive noise in the rear axle assembly.

8.11 (Replace Pinion Seal) Given a vehicle with a leaking pinion seal, access to the proper hand tools, equipment, parts and service manual; replace the pinion seal according to the manufacturer's recommended procedures.

8.12 (Diagnose Differential Malfunctions) Given a car with known differential defect(s), conduct a diagnostic check or road test under instructor's supervision.

8.13 (Repair or Replace Differential) Given an automobile with a repairable defect in the differential, and access to the proper tools, equipment, and service manual; repair the defective parts (or replace, if necessary) in accordance with the manufacturer's procedures and specifications.

UNIT 8.0 B DRIVE TRAIN - LEVEL II

TASK 8.01 ADJUST CLUTCH

---

PERFORMANCE OBJECTIVE:

On a given vehicle requiring a clutch adjustment, service data and necessary tools and equipment; check for proper adjustment of the clutch and make the necessary adjustments to meet service data specifications.

PERFORMANCE ACTIONS:

8.0101 Check clutch specifications in service data.

8.0102 Measure pedal height and adjust pedal; stop bolt for proper height as necessary.

8.0103 Observe amount of pedal free play.

8.0104 Adjust linkage for proper free play.
  a. Loosen linkage adjustment nut
  b. Move it up or down rod as necessary
  c. For cable-operated clutch linkage, adjust by lengthening or shortening clutch cable housing.

8.0105 After adjustment, measure free play.

8.0106 If appropriate, check hydraulic clutch linkage and adjust.

8.0107 Check pedal free play.

PERFORMANCE STANDARDS:

- Determine proper clutch pedal height and free play and make necessary adjustments to meet vehicle service data specifications.
- Student's measurements should agree with instructor's findings.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 8.0 B DRIVE TRAIN - LEVEL II

TASK 8.02 REPAIR AND REPLACE SLIP-JOINTS, U-JOINTS

---

PERFORMANCE OBJECTIVE:

Given a vehicle requiring lubrication service to the universal joints, and access to the proper tools, equipment, and service manual; lubricate the universal joints following the manufacturer's recommended procedures and specifications. Upon completion, the U-joints will function without leaking around seals.

(NOTE: Cross-and-yoke U-joints used for description.)

PERFORMANCE ACTIONS:

8.0201 Raise automobile for access to the drive shaft.

8.0202 Remove drive shaft (Mark shaft to allow proper alignment during reinstallation.)

8.0203 Using U-joints press or vise to hold the drive shaft steady, disassemble the U-joint.

8.0204 Remove U-joints clips or locking device (bearing caps).

8.0205 If the U-joint is being removed for lubricating, clean out the old grease as much as possible and check the condition of the bearing seals, replace the joint if wear is evident or seals damaged.

8.0206 Before installing a new joint, check to determine if it has ample lubrication.

8.0207 Install the repacked or replacement U-joint.

8.0208 Install clips or locking devices being sure that they are located properly and seated.

8.0209 Reinstall the drive shaft in the vehicle.

8.0210 Road test to check performance.

PERFORMANCE STANDARDS:

- Lubricate the universal joints on an automobile provided by the instructor.
- Performance must be to instructor's standards.
- Lubricate and replace U-joints to manufacturer's specifications.

TASK 8.02 REPAIR AND REPLACE SLIP-JOINTS, U-JOINTS (Con't.)

---

SUGGESTED INSTRUCTION TIME: 4 Hours

RELATED TECHNICAL INFORMATION:

- Determine proper lubricate according to specifications.
- Handling of drive shaft.
- Demonstrate ability to determine if U-joint is defective or not.

UNIT 8.0 B DRIVE TRAIN - LEVEL II

TASK 8.03 REPAIR, REPLACE, OR ADJUST FRONT DRIVE AXLE ASSEMBLIES

---

PERFORMANCE OBJECTIVE:

Provided a vehicle with a malfunctioning front drive axle assembly; and access to the proper hand tools, equipment, and service manual; adjust or replace the front drive axle assembly in accordance with the manufacturer's specifications and procedures.

PERFORMANCE ACTIONS:

8.0301 Lift vehicle and place stands under frame.

8.0302 Drain the differential.

8.0303 Remove front tires and wheels.

8.0304 Remove drive shaft with joint from differential.

8.0305 Remove lower ends of front shocks.

8.0306 Disconnect front brake line at flex line.

8.0307 Remove front spring bolts.

8.0308 Lift axle assembly up and remove from either side.

8.0309 To reinstall new axle assembly, reverse the steps.

8.0310 Fill brake master cylinder and bleed front brakes.

8.0311 Refill master cylinder.

8.0312 Fill differential with proper lubrication.

PERFORMANCE STANDARDS:

- Adjust or replace front drive axle assembly in accordance to manufacturer's service data.

SUGGESTED INSTRUCTION TIME: 16 Hours

UNIT 8.0 B DRIVE TRAIN - LEVEL II

TASK 8.04 REPLACE MANUAL TRANSMISSION REAR SEAL, GASKET, AND BUSHING (IN CAR REPAIRS)

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PERFORMANCE OBJECTIVE:

Provided a standard transmission, and access to the proper hand tools, equipment, and service manual; replace the rear seal and bushing following the manufacturer's recommended procedures. Upon completion, there will be no leaks or excessive noise in the repaired areas.

PERFORMANCE ACTIONS:

8.0401 All safety procedures must be followed. Raise vehicle and place safety stands under frame.

8.0402 Drain transmission.

8.0403 Remove drive shaft.
(NOTE: Mark drive shaft.)

8.0404 Remove output shaft housing from transmission. If transmission mount attaches to housing, the transmission must be supported by a jack.

8.0405 Using proper tools, remove and replace the seal and bushing.

8.0406 Install housing, using new gaskets.

8.0407 Install drive shaft.

8.0408 Refill transmission.

8.0409 Test and check for leaks or excessive noise.

PERFORMANCE STANDARDS:

- Replace rear seal and bushing following manufacturer's service data. There must be no leaks or excessive noise from the completed repair.

SUGGESTED INSTRUCTION TIME: 4 Hours

RELATED TECHNICAL INFORMATION:

- Use of transmission jack and transmission-to-jack safety chains.

UNIT 8.0 B DRIVE TRAIN - LEVEL II

TASK 8.05 REMOVE AND REPLACE CLUTCH, DISC PRESSURE PLATE, RELEASE (THROWOUT) BEARING, PILOT BEARING (BUSHING), AND ADJUST EXTERNAL SHAFT LINKAGE ON MANUAL TRANSMISSION

---

## PERFORMANCE OBJECTIVE:

Given a vehicle with a faulty pilot bearing, clutch disc pressure plate or release bearing, and access to the proper tools, equipment, and service manual; replace the pilot bearing following the manufacturer's recommended procedures and specifications.

## PERFORMANCE ACTIONS:

8.0501 All safety procedures must be followed. Jack up vehicle and place safety stands under frame.

8.0502 Drain transmission.

8.0503 Remove drive shaft.

8.0504 Using proper jack, remove transmission.

8.0505 Remove clutch bearing, pressure plate, and disc.

8.0506 With correct puller, remove pilot bearing from fly wheel.

8.0507 Install new pilot bearing.

8.0508 Install clutch, using aligning tool.

8.0509 Install transmission.

8.0510 Install drive shaft.

8.0511 Refill transmission with specified lubricant.

8.0512 Adjust external shaft linkage as follows:
a. If shifter is on column or floor place in neutral.
b. Loosen clamps on linkage and adjust to manufacturer's specifications.
c. Retighten clamps and check for smooth shifting in all gears.
d. Repeat process if still loose or too tight.

8.0513 Test for operation.

UNIT 8.0 B DRIVE TRAIN - LEVEL II

TASK 8.05 REMOVE AND REPLACE CLUTCH, DISC PRESSURE PLATE, RELEASE (THROWOUT) BEARING, PILOT BEARING (BUSHING), AND ADJUST EXTERNAL SHAFT LINKAGE ON MANUAL TRANSMISSION (Con't.)

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PERFORMANCE STANDARDS:

- Remove and replace clutch, disc pressure plate, release (throwout) bearings, pilot bearings (bushings) and adjust external shaft linkage on manual transmission following manufacturer's recommended procedures and meeting service data specifications.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 8.0 B DRIVE TRAIN - LEVEL II

TASK 8.06 REPLACE TRANSMISSION MOUNTS

---

PERFORMANCE OBJECTIVE:

Provided a vehicle with faulty transmission mounts, and access to the proper hand tools, equipment and service manual; replace the transmission mounts following the manufacturer's recommended procedures and specifications. Upon completion, the mounts will be secure so that no noise or shimmying in the transmission occurs.

PERFORMANCE ACTIONS:

8.0601 All safety procedures must be followed. Jack up vehicle and place safety stand under frame.

8.0602 With suitable jack support rear of motor transmisssion.

8.0603 Remove mount bolts and mounts. On some vehicles the transmission must be raised to remove the mounts.

8.0604 Place new transmission mounts into position and torque to specifications, if necessary.

8.0605 Remove support jacks and put car on floor.

8.0606 Start engine and check mounts for looseness.

PERFORMANCE STANDARDS:

- Replace faulty transmission mounts so mounts are secure with no noise or shimmying.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 8.0 B DRIVE TRAIN - LEVEL II

TASK 8.07 TEST MANUAL TRANSMISSION OPERATION

---

## PERFORMANCE OBJECTIVE:

Given a vehicle with a malfunction in the manual transmission, and access to the proper tools, equipment, and service manual, check the transmission in all speeds and identify the problem(s). Problem identification must be the same as the instructor's.

## PERFORMANCE ACTIONS:

8.0701 Jack up car and place safety stand under frame. All safety procedures must be followed.

8.0702 Visually inspect the transmission for damage or leaks.

8.0703 Start engine and test for which gear(s) the malfunction occurs.

8.0704 Determine what the malfunction is. (Clanging noise, whining, grinding noise, etc.)

8.0705 If no malfunction, lower car and road test.

## PERFORMANCE STANDARDS:

- Check a manual transmission in all speeds and identify any problems that occur.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 8.0 B DRIVE TRAIN - LEVEL II

TASK 8.08 REPLACE MANUAL TRANSMISSION

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PERFORMANCE OBJECTIVE:

Given a vehicle with a manual transmission, and access to the proper tools, equipment, and service manual; replace the transmission following the manufacturer's procedures and specifications. When completed, the transmission will not leak, shimmy, or contain problems in shifting.

PERFORMANCE ACTIONS:

8.0801 All safety procedures must be followed, jack up vehicle and place safety stands under frame.

8.0802 Drain transmission.

8.0803 Remove drive shaft.

8.0804 If mounts are attached to transmission, the rear of the motor must be supported with a jack and the mounts removed.

8.0805 Remove transmission.

8.0806 To install, reverse procedure.

8.0807 Refill transmission with lubricant.

8.0808 Road test for problems.

PERFORMANCE STANDARDS:

- On a given vehicle, replace the manual transmission following the manufacturer's procedures and adjusting the transmission to meet service data specifications.
- The newly installed transmission must not leak, shimmy, or contain problems in shifting.

SUGGESTED INSTRUCTION TIME: 6 Hours

UNIT 8.0 B DRIVE TRAIN - LEVEL II

TASK 8.09 REBUILD MANUAL TRANSMISSION

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PERFORMANCE OBJECTIVE:

Provided a standard transmission with known defects, and access to the proper hand tools, equipment, and service manual; disassemble and repair the defective components of the transmission, following the manufacturer's recommended procedures and specifications. All known defects in the transmission must be identified and repaired.

PERFORMANCE ACTIONS:

8.0901 Locate the manufacturer's information and specifications on the given transmission.

8.0902 Remove the transmission cover and visually inspect all visible gears, synchronizers, and spacers.

8.0903 Following the manufacturer's disassembly procedures, disassemble the transmission and check the parts for nicks, burrs, or broken gear teeth.

8.0904 Check cluster gear for correct thickness spacers with a caliper micrometer against manufacturer's recommended thickness.

8.0905 Check all other components in the transmission for wear, leaks, or other problems.

8.0906 When the problem(s) is located, repair the malfunction.

8.0907 Make sure the cause of the malfunction is corrected, as well as the defective parts.

8.0908 Reassemble the transmission and test it for proper functioning.

PERFORMANCE STANDARDS:

- Disassemble and repair a defective component of the transmission according to the manufacturer's recommended procedures and specifications.
- All known defects in the transmission must be identified and repaired.

SUGGESTED INSTRUCTION TIME: 16 Hours minimum

UNIT 8.0 B DRIVE TRAIN - LEVEL II

TASK 8.10 REPLACE REAR AXLE SHAFT, BEARING AND SEAL

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PERFORMANCE OBJECTIVE:

Provided a vehicle, and access to the proper hand tools, equipment, and service manual; replace the rear axle shaft, bearings and seal following the manufacturer's recommended procedures and specifications. Upon completion, there will be no leaks or excessive noise in the rear axle assembly.

PERFORMANCE ACTIONS:

8.1001 Lift vehicle.

8.1002 Remove rear wheel.

8.1003 Remove rear brake drum.

8.1004 Remove axle bearing retainer bolts, if necessary.

8.1005 Remove axle shaft.

8.1006 Remove bearing from shaft.

8.1007 Clean axle shaft.

8.1008 Dress new bearings on shaft.

8.1009 Reverse disassembly procedures to reassemble the components.

PERFORMANCE STANDARDS:

- Remove and replace the rear axle shaft, bearings and seal on a given drive train following manufacturer's procedures and specifications. Upon completion, there must be no leaks or excessive noise in the rear axle assembly.

SUGGESTED INSTRUCTION TIME: 12 Hours

UNIT 8.0 B DRIVE TRAIN - LEVEL II

TASK 8.11 REPLACE PINION SEAL

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PERFORMANCE OBJECTIVE:

Given a vehicle with a leaking pinion seal, access to the proper hand tools, equipment, parts and service manual; replace the pinion seal according to the manufacturer's recommended procedures.

PERFORMANCE ACTIONS:

8.1101 Raise vehicle from floor.

8.1102 Remove rear drive shaft with joint from differential.

8.1103 Place drain pan under front of differential.

8.1104 Remove pinion nut.

8.1105 Remove yoke from pinion shaft.

8.1106 Remove pinion seal using a seal puller.

8.1107 Clean housing and yoke.

8.1108 Replace pinion seal using a seal driver.

8.1109 Inspect yoke for damage or wear.

8.1110 Replace yoke, if necessary.

8.1111 Tighten to manufacturer's specifications.

8.1112 Replace drive shaft.

8.1113 Check and fill differential with proper lubrication.

8.1114 Check and clean air vent.

PERFORMANCE STANDARDS:

- Replace pinion seal in a given vehicle according to manufacturer's recommended procedures.

SUGGESTED INSTRUCTION TIME: 8 Hours

UNIT 8.0 B DRIVE TRAIN - LEVEL II

TASK 8.12 DIAGNOSE DIFFERENTIAL MALFUNCTIONS

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PERFORMANCE OBJECTIVE:

Given a car with known differential defect(s), conduct a diagnostic check or road test under instructor's supervision.

PERFORMANCE ACTIONS:

8.1201 Prior to road testing for drive axle assembly problems, check the lubricant level. Add lubricant as necessary.

8.1202 Check tires for saw tooth wear pattern or for mud and snow tires design which might produce vibrations or noise.

8.1203 Bring tire pressure to specifications.

8.1204 Drive vehicle far enough to warm lubricant.

8.1205 Check action during: (a) drive, (b) cruise (engine driving enough to maintain car speed), (c) float (engine neither driving nor holding back)--car speed allowed to slowly decrease), and (d) coast (accelerator released, engine on compression).

8.1206 During the road test, noise produced by front wheel bearings often can be reduced or altered by pressing on the brake while maintaining car speed.

8.1207 Operate engine with the car standing still, at the approximate RPM at which the sound was noticed during the road test. If the sound is noticed during this test, it is obvious that the problem is not in the drive axle.

PERFORMANCE STANDARDS:

- Road test a given vehicle to diagnose differential malfunctions.
- Findings must be in agreement with the findings of the instructor.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 8.0 B DRIVE TRAIN - LEVEL II

TASK 8.13 REPAIR OR REPLACE DIFFERENTIAL

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## PERFORMANCE OBJECTIVE:

Given an automobile with a repairable defect in the differential, and access to the proper tools, equipment, and service manual; repair the defective parts (or replace, if necessary) in accordance with the manufacturer's procedures and specifications.

## PERFORMANCE ACTIONS:

8.1301 Raise vehicle from floor.

8.1302 Drain the differential.

8.1303 Remove rear tires and wheels.

8.1304 Remove rear brake drums.

8.1305 Remove all backing plate bolts.

8.1306 Remove rear axle.

8.1307 Remove drive shaft with joint at differential.

8.1308 Remove bolt or nut holding carrier assemble to axle housing.

8.1309 Remove carrier assembly from axle housing.

8.1310 Clean carrier assembly.

8.1311 Mark the adjusting caps and nuts for identification.

8.1312 Remove adjusting cap bolts.

8.1313 Remove rear gear and carrier assembly by lifting out housing.

8.1314 Remove pinion nut.

8.1315 Remove yoke from pinion shaft.

8.1316 Remove pinion seal.

8.1317 Remove pinion and pinion bearings.

8.1318 Remove axle gears and spider gears.

PERFORMANCE ACTIONS (Con't.):

8.1319 Replace rear bearing on pinion shaft.

8.1320 Install pinion shaft in housing, install outer or front bearing and yoke.

8.1321 Preload bearings to manufacturer's specifications with new crush rings.

8.1322 Remove yoke, install pinion seal.

8.1323 Assemble ring gear, spider and axle gears.

8.1324 Install assembly in carrier making sure the adjusting caps and nuts are on the right marked side.

PERFORMANCE STANDARDS:

- Remove, repair, and replace differential with all components installed and working properly, according to manufacturer's specifications.
- Recognize defective or broken components, visually check and detect differential leaks or faulty components.

SUGGESTED INSTRUCTION TIME: 16 Hours

## TASK LISTINGS
## AUTOMOTIVE MECHANICS

| UNIT/TASK | DESCRIPTION |
|---|---|
| Unit 8.0 C | AUTOMATIC TRANSMISSION MAINTENANCE AND REPAIR |
| 8.01 | (Perform Operational Tests on Automatic Transmission) Given a vehicle and access to a service manual; perform an operational test, in all selector speeds, of an automatic transmission and identify any malfunctions that exist. All malfunctions identified by the instructor must be recognized. |
| 8.02 | (Adjust Column-Type Linkage) Using the proper service manual, hand tools, and equipment; adjust the transmission linkage on a given automobile, following the manufacturer's specifications and recommended procedures. |
| 8.03 | (Adjust Floor Linkage) Provide a vehicle with floor-mounted transmission linkage, access to a service manual, hand tools, and equipment; adjust the transmission linkage in accordance with the manufacturer's recommended procedures and specifications. |
| 8.04 | (Adjust Linkage From Engine to Automatic Transmission) Given a vehicle with an automatic transmission, and access to the proper hand tools, equipment, and service manual; adjust the engine-to-transmission linkage in accordance with the manufacturer's recommended procedures and specifications. |
| 8.05 | (Clean and Visually Inspect Transmission) Given a vehicle and access to the appropriate cleaning materials, clean the transmission and inspect it for leaks under the instructor's supervision. All transmission leaks identified by the instructor must be recognized. |
| 8.06 | (Diagnose, Replace, or Adjust Modulators) Given a vehicle with the modulator valve in the transmission out of adjustment, and access to a service manual and the proper tools and equipment; adjust the modulator valve to meet the manufacturer's specifications for proper operation. |
| 8.07 | (Service Filter) Given a vehicle and access to the proper hand tools, equipment, and service manual; clean or replace the automatic transmission filter following the manufacturer's recommended procedure. Upon completion related parts will not leak transmission fluid. |

8.08 (Replace or Adjust Neutral Safety Switch) Given a vehicle, and access to the proper hand tools, equipment, and service manual; replace the neutral switch on the automatic transmission following the manufacturer's recommended procedure.

8.09 (Make Band Adjustments [Internal or External]) Given a vehicle and access to the proper hand tools, equipment, and service manual; make adjustments of the automatic transmission bands, following the manufacturer's recommended procedures and specifications. Upon completion, the clutch will engage fully and not slip.

8.10 (Remove and Install Automatic Transmission) Given a vehicle with an automatic transmission that is unrepairable, and access to the proper tools, equipment, and service manual; remove and replace the transmission according to the manufacturer's specifications and procedures. Upon completion, the transmission will operate without leaks, vibrations, or unusual noises.

8.11 (Replace External Seals, Gaskets, and Lines on Automatic Transmission) Provided a vehicle with an automatic transmission, and access to the proper hand tools, equipment, and service manual; replace the rear transmission seal and bushing following the manufacturer's recommended procedures and specifications. Upon completion, there will be no leaks around the replaced components.

8.12 (Inspect, Remove, and Replace Converter) Provided a vehicle with a defective converter, and access to the proper tools, equipment, and service manual; replace the torque converter following the manufacturer's recommended procedures and specifications. Upon completion, there will be no damage to other components of the transmission, and the transmission will not leak fluid.

8.13 (Overhaul Automatic Transmission) Given an automatic transmission in need of an overhaul, and access to the proper hand tools, equipment, and service manual; overhaul the transmission in accordance with the manufacturer's specifications and procedures. When completed, the transmission will operate without leaks, vibrations, or unwarranted noise.

UNIT 8.0 C DRIVE TRAIN - LEVEL III

TASK 8.01 PERFORM OPERATIONAL TESTS ON AUTOMATIC TRANSMISSION

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PERFORMANCE OBJECTIVE:

Given a vehicle and access to a service manual; perform an operational test, in all selector speeds, of an automatic transmission and identify any malfunctions that exist. All malfunctions identified by the instructor must be recognized.

PERFORMANCE ACTIONS:

8.0101 Check transmission fluid.

8.0102 Check operation at varying speeds.

8.0103 Check transmission under various operational conditions.

8.0104 Check for leaks, both fluid and vacuum.

PERFORMANCE STANDARDS:

- Perform an operational test on given automatic transmission and identify any malfunctions that exist, identifying all malfunctions found by the instructor.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 8.0 C DRIVE TRAIN - LEVEL III

TASK 8.02 ADJUST COLUMN-TYPE LINKAGE

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## PERFORMANCE OBJECTIVE:

Using the proper service manual, hand tools, and equipment; adjust the transmission linkage on a given automobile, following the manufacturer's specifications and recommended procedures.

## PERFORMANCE ACTIONS:

8.0201 Loosen the adjustment clamp at the cross shaft.

8.0202 Rotate the transmission lever to drive position.

8.0203 Set the selector level to D (drive) and remove any free play by rotating and holding the cross shaft upward and pulling the shift rod down.

8.0204 Tighten the clamp and recheck the adjustment.

8.0205 Readjust the indicator needle if necessary to agree with the transmission detent position.

8.0206 Readjust the neutral safety switch if necessary.

## PERFORMANCE STANDARDS:

- Adjust the transmission linkage (column-type) on a given automobile, following manufacturer's specifications are recommended procedures.

SUGGESTED INSTRUCTION TIME: 2 Hours

## RELATED TECHNICAL INFORMATION:

- On older vehicle, inspect wear of engine mounts and if mounts are worn, do not waste time adjusting linkage since further wear will cause engine and transmission to shift.

UNIT 8.0 C DRIVE TRAIN - LEVEL III

TASK 8.03 ADJUST FLOOR LINKAGE

---

PERFORMANCE OBJECTIVE:

Provided a vehicle with floor-mounted transmission linkage, access to a service manual, hand tools and equipment; adjust the transmission linkage in accordance with the manufacturer's recommended procedures and specifications.

PERFORMANCE ACTIONS:

8.0301 Place the selector level in D (drive) and raise vehicle on a hoist.

8.0302 Disconnect the cable from the transmission lever.

8.0303 Move the lever to drive by rotating it counterclockwise to L (low) and then back on detent.

8.0304 Measure the distance from the rearward face of the attachment bracket to the center of the cable attachment pin.

8.0305 Adjust the pin if necessary.

8.0306 Install cable to the transmission lever, lower the car, and check adjustment.

PERFORMANCE STANDARDS:

- Adjust floor linkage according to manufacturer's recommended procedures and specifications.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 8.0 C DRIVE TRAIN - LEVEL III

TASK 8.04 ADJUST LINKAGE FROM ENGINE TO AUTOMATIC TRANSMISSION

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## PERFORMANCE OBJECTIVE:

Given a vehicle with an automatic transmission, and access to the proper hand tools, equipment, and service manual; adjust the engine-to-transmission linkage in accordance with the manufacturer's recommended procedures and specifications.

## PERFORMANCE ACTIONS:

8.0401 Raise hood of car, remove air cleaner and disconnect the accelerator linkage at the carburetor.

8.0402 Disconnect the accelerator-return and TV-rod springs.

8.0403 With the right hand, pull the TV upper rod forward until the transmission is through the detent.

8.0404 With the left hand, open the carburetor to wide-open-throttle position.

8.0405 Adjust swivel on upper end of TV rod as necessary.

8.0406 Connect and adjust the accelerator linkage as necessary, and check for freedom of movement in linkage and road test.

## PERFORMANCE STANDARDS:

- Adjust engine-to-transmission linkage according to manufacturer's recommended procedures and specifications.

SUGGESTED INSTRUCTION TIME: 2 Hours

## RELATED TECHNICAL INFORMATION:

- (NOTE: If TV (throttle valve) lever must be bent, use special bending tool to avoid possible internal damage.)

UNIT 8.0 C DRIVE TRAIN - LEVEL III

TASK 8.05 CLEAN AND VISUALLY INSPECT TRANSMISSION

---

PERFORMANCE OBJECTIVE:

Given a vehicle and access to the appropriate cleaning materials, clean the transmission and inspect it for leaks under the instructor's supervision. All transmission leaks identified by the instructor must be recognized.

PERFORMANCE ACTIONS:

8.0501 Raise the vehicle in a safe manner to enable access to the transmission.

8.0502 Clean the transmission exterior with a cleaning device.

8.0503 Operate the vehicle until the engine and transmission have achieved operating temperature.

8.0504 Inspect the transmission exterior for leakage. Specifically inspect the following exterior areas for leakage:

a. Transmission oil pan.
b. Front and rear seals.
c. Transmission drain plug (for looseness) if applicable.
d. Check oil cooler and speedometer drive.
e. Remove vacuum hose from modulator and note leaks.

PERFORMANCE STANDARDS:

- On a given vehicle, clean, and visually inspect the transmission and identify any transmission leaks.
- Meet instructor's standards.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 8.0 C DRIVE TRAIN - LEVEL III

TASK 8.06 DIAGNOSE, REPLACE, OR ADJUST MODULATORS

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## PERFORMANCE OBJECTIVE:

Given a vehicle with the modulator valve in the transmission out of adjustment, and access to a service manual and the proper tools and equipment; adjust the modulator valve to meet the manufacturer's specifications for proper operation.

## PERFORMANCE ACTIONS:

8.0601 Raise car and support on stands.

8.0602 Place drain pan under car to catch oil.

8.0603 Disconnect vacuum line.

8.0604 If modulator is adjustable type, count number of turns to remove modulator.

8.0605 Install a new modulator (if necessary) the same number of turns.

8.0606 Reconnect vacuum line and road check for shift pattern.

8.0607 Readjust if necessary.

(NOTE: Check modulator with vacuum pump for vacuum leaks.)

## PERFORMANCE STANDARDS:

- Diagnose, replace, or adjust the modulator valve to meet the manufacturer's specifications for proper operation.
- Road test the vehicle for proper shift pattern.

SUGGESTED INSTRUCTION TIME: 2 Hours

| | | |
|---|---|---|
| UNIT | 8.0 C | DRIVE TRAIN - LEVEL III |
| TASK | 8.07 | SERVICE FILTER |

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PERFORMANCE OBJECTIVE:

Given a vehicle and access to the proper hand tools, equipment, and service manual; clean or replace the automatic transmission filter following the manufacturer's recommended procedures. Upon completion related parts will not leak transmission fluid.

PERFORMANCE ACTIONS:

8.0701 Raise the vehicle to obtain access to the drive line and transmission.

8.0702 Clean transmission and dust cover on torque converter.

8.0703 Follow manufacturer's recommended procedures and specifications to install filter.

8.0704 Refill with fluid.

8.0705 Test for leaks.

PERFORMANCE STANDARDS:

- Clean or replace the automatic transmission filter following the manufacturer's recommended procedures.
- Upon completion, there must be no leaks of transmission fluid.

SUGGESTED INSTRUCTION TIME: 4 Hours

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|---|---|---|
| UNIT | 8.0 C | DRIVE TRAIN - LEVEL III |
| TASK | 8.08 | REPLACE OR ADJUST NEUTRAL SAFETY SWITCH |

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## PERFORMANCE OBJECTIVE:

Given a vehicle, and access to the proper hand tools, equipment, and service manual; replace the neutral switch on the automatic transmission following the manufacturer's recommended procedures.

## PERFORMANCE ACTIONS:

8.0801 Raise vehicle on jack stands and place oil pan under transmission.

8.0802 Disconnect wire from the neutral switch and remove switch from transmission case.

8.0803 Install a new switch using the new O-ring.

8.0804 Reconnect wire to neutral switch.

8.0805 Check to be certain it starts in park or neutral; if not, adjust the manual linkage.

If switch is on the steering column, do the following:
a. Locate switch on the steering column.
b. Disconnect multi-prong wire connector.
c. Loose the two attaching screws to the switch.
d. Place the switch into position, tighten screws and connect.
e. Adjust the switch until car starts in park or neutral.

## PERFORMANCE STANDARDS:

- Replace or adjust neutral switch on automatic transmission following manufacturer's recommended procedures.
- Vehicle should start in park or neutral, but not in any other position.

SUGGESTED INSTRUCTION TIME: 3 Hours

| | | |
|---|---|---|
| UNIT | 8.0 C | DRIVE TRAIN - LEVEL III |
| TASK | 8.09 | MAKE BAND ADJUSTMENTS (INTERNAL OR EXTERNAL) |

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PERFORMANCE OBJECTIVE:

Given a vehicle and access to the proper hand tools, equipment, and service manual; make adjustments of the automatic transmission bands, following the manufacturer's recommended procedures and specifications. Upon completion, the clutch will engage fully and not slip.

PERFORMANCE ACTIONS:

8.0901 Determine whether adjustment is to be made on exterior or interior band adjusters.

8.0902 If interior, remove transmission oil pan, and drain oil.

8.0903 Loosen lock nut and turn adjustor correct number of turns according to manufacturer's specifications.

8.0904 If external, locate adjusting screw.

8.0905 Remove protective cap.

8.0906 Loosen lock nut.

8.0907 Adjust to manufacturer's specifications.

8.0908 Refill transmission fluid to proper level and check for leaks.

PERFORMANCE STANDARDS:

- Adjust automatic transmission bands, internal or external, following manufacturer's recommended procedures and specifications.
- Upon completion, the clutch will engage fully and not slip.
- No transmission leaks will be observed.

SUGGESTED INSTRUCTION TIME: 6 Hours

UNIT 8.0 C DRIVE TRAIN - LEVEL III

TASK 8.10 REMOVE AND INSTALL AUTOMATIC TRANSMISSION

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## PERFORMANCE OBJECTIVE:

Given a vehicle with an automatic transmission that is unrepairable, and access to the proper tools, equipment, and service manual; remove and replace the transmission according to the manufacturer's specifications and procedures. Upon completion, the transmission will operate without leaks, vibrations, or unusual noises.

## PERFORMANCE ACTIONS:

8.1001 Raise vehicle in a safe manner to enable access to the transmission.

8.1002 Locate proper service manual for information on procedures of removal and replacement of transmission and converter assembly.

8.1003 Drain transmission fluid.

8.1004 Support engine with jack.

8.1005 Remove the drive shaft.

8.1006 Remove transmission mount and frame cross member.

8.1007 Disconnect shift linkage, speedometer cable, filler tube, oil cooler lines, and modular tubes and/or wires.

8.1008 Remove converter to flywheel bolts.

8.1009 Disconnect battery ground cable from battery.

8.1010 Remove starter motor.

8.1011 Remove transmission to engine bolts and remove transmission and converter assembly with the use of a transmission jack.

8.1012 Reverse procedure for installation and refill fluid and have rear wheel off floor while filling fluid.

8.1013 Road test vehicle to ascertain proper transmission performance.

TASK 8.10 REMOVE AND INSTALL AUTOMATIC TRANSMISSION (Con't.)

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PERFORMANCE STANDARDS:

- On a given automobile, remove, and install an automatic transmission according to manufacturer's specifications and procedures.
- Upon completion, the transmission will operate without leaks, vibration, or unusual noises.

SUGGESTED INSTRUCTION TIME: 8 Hours

UNIT 8.0 C DRIVE TRAIN - LEVEL III

TASK 8.11 REPLACE EXTERNAL SEALS, GASKETS, AND LINES ON AUTOMATIC TRANSMISSION

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PERFORMANCE OBJECTIVE:

Provided a vehicle with an automatic transmission, and access to the proper hand tools, equipment, and service manual; replace the rear transmission seal and bushing following the manufacturer's recommended procedures and specificatons. Upon completion, there will be no leaks around the replaced components.

PERFORMANCE ACTIONS:

8.1101 Raise the vehicle to obtain access to the drive line and transmission.

8.1102 Locate the proper service manual for information on replacement of transmission rear oil seal and the extension housing bushing.

8.1103 Remove the drive shaft and inspect the yoke for wear.

8.1104 Following the prescribed procedure using the proper tools; remove and replace the seal and bushing.

8.1105 Install the drive shaft.

8.1106 Adjust the fluid level, if necessary.

8.1107 Check the seal for oil leaks.

8.1108 Road test for proper operation.

PERFORMANCE STANDARDS:

- On a given vehicle, replace the rear transmission seal and bushing following the manufacturer's recommended procedures and specifications.
- There must be no leaks when completed.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 8.0 C DRIVE TRAIN - LEVEL III

TASK 8.12 INSPECT, REMOVE, AND REPLACE CONVERTER

---

PERFORMANCE OBJECTIVE:

Provided a vehicle with a defective converter, and access to the proper tools, equipment, and service manual; replace the torque converter following the manufacturer's recommended procedures and specifications. Upon completion, there will be no damage to other components of the transmission, and the transmission will not leak fluid.

PERFORMANCE ACTIONS:

8.1201 Place automobile on lift.

8.1202 Disconnect battery.

8.1203 Drain oil from transmission.

8.1204 Disconnect all component parts.

8.1205 Remove propeller shaft.

8.1206 Place transmission jack under transmission.

8.1207 Remove mounting bolts and raise transmission slightly.

8.1208 Remove cross member.

8.1209 Lower transmission slightly.

8.1210 Remove torque convertor to flex plate bolts.

8.1211 Remove bell housing bolts.

8.1212 Move transmission slightly to rear and lower.

8.1213 Remove transmission jack.

PERFORMANCE STANDARDS:

- Inspect, remove and replace the torque converter following manufacturer's recommended procedures and specifications.
- Upon completion, there must be no damage to other components of the transmission and the transmission must not leak fluid.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 8.0 C DRIVE TRAIN - LEVEL III

TASK 8.13 OVERHAUL AUTOMATIC TRANSMISSION

---

## PERFORMANCE OBJECTIVE:

Given an automatic transmission in need of overhaul, and access to the proper hand tools, equipment, and service manual; overhaul the transmission in accordance with the manufacturer's specifications and procedures. When completed, the transmission will operate without leaks, vibrations, or unwarranted noise.

## PERFORMANCE ACTIONS:

8.1301 Clean outside of transmission.

8.1302 Prepare for disassembly.

8.1303 Remove converter.

8.1304 Remove oil pan and valve body.

8.1305 Install dial indicator and check end play.

8.1306 Remove front oil pump, front band, and front clutch assembly.

8.1307 Remove extension housing, governor, and rear pump.

8.1308 Remove rear planetary unit and output shaft.

8.1309 Remove overrunning clutch and rear band assembly.

8.1310 Remove servo retainer and servo pistons.

8.1311 Clean all transmission parts and replace defective components where necessary.

8.1312 Reassemble transmission by reversing above procedures.

## PERFORMANCE STANDARDS:

- Overhaul a given automatic transmission according to manufacturer's specifications and procedures so that the transmission operates properly without leaks, vibrations, or unwarranted noise.

SUGGESTED INSTRUCTION TIME: 12 Hours

| UNIT/TASK | DESCRIPTION |
|---|---|
| Unit 9.0 | WHEELS AND TIRES |
| 9.01 | (Remove and Replace Tire, Tube, and Rim Assembly) On a given vehicle, remove and replace the tire, tube if applicable, and rim assembly so that serviced wheel is safe and meets manufacturer's specifications. |
| 9.02 | (Repair Flat Tire) Given an automobile with a flat tire, repair the tire by removing it from the rim, repairing the leak as appropriate, and remounting the tire on the rim according to manufacturer's recommendations. |
| 9.03 | (Recognize Both Causes and Remedies of Abnormal Tire Wear) On a given automobile, inspect the tire casting and thread for wear and damage in accordance with given specification. |
| 9.04 | (Perform Front Wheel Bearing Services, Remove, Clean, Lubricate, Replace, and Adjust) Given a vehicle, wheel bearing lubricant, proper tools, and service manual; repack the inner and outer front wheel bearings following the manufacturer's specifications and procedures, adjust the front bearings to meet the manufacturer's specifications. |
| 9.05 | (Speed Balance Wheels and Tires) Given an automobile with unbalanced wheels, wheel weights, and access to a service manual and the proper tools and equipment; balance the wheels and tires following the manufacturer's procedures. |
| 9.06 | (Diagnose Tire and Wheel Malfunctions) Given an automobile, check the tires and wheels and report any malfunctions with recommendations on correcting malfunctions that cannot be corrected by typical service such as adding or reducing air pressure. Finding recommendations must agree with the instructor's findings. |

UNIT 9.0 WHEELS AND TIRES - LEVEL I

TASK 9.01 REMOVE AND REPLACE TIRE, TUBE, AND RIM ASSEMBLY

---

PERFORMANCE OBJECTIVE:

On a given vehicle, remove and replace the tire, tube if applicable, and rim assembly so that the serviced wheel is safe and meets manufacturer's specifications.

PERFORMANCE ACTIONS:

9.0101 Identify tire and rim type and size.

9.0102 Inspect the tire and wheel assembly for improper wear pattern or other defects. Check pressure after the tires are cool and inspect for bulges, tread groove wear, and other indications that service may be required.

9.0103 Remove the wheel from the vehicle. Observe correct procedures in using impact tools.

9.0104 Demount the tire from the rim using the shop tire changer. If the tire is to be reinstalled, chalkmark it.
(CAUTION: Observe proper safety precautions when deflating the tire, dismounting it using the tire changer, etc.)

9.0105 If the tire is to be remounted on the rim, inspect the inside of the tire to determine the condition.

9.0106 Remount the serviced tire or new tire using the tire changer. Use a coating solution (rummber lubricant or soap-and-water) on remounting the tire. Make sure the tire is aligned on the wheel rim.

9.0107 Make sure the bead has sealed to the rim. Install the valve core and inflate the tire to recommended pressure.

PERFORMANCE STANDARDS:

- Remove and replace the tire, tube if applicable, and rim assembly on a given automobile.

TASK 9.01 REMOVE AND REPLACE TIRE, TUBE, AND RIM ASSEMBLY (Con't.)

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PERFORMANCE STANDARDS (Con't.):

- Upon completion, the repaired tire and wheel will be safe, tire inflated to recommended pressure, and the tire and rim installed properly.
- No damage should result to lug nuts or replaced hub cap.

SUGGESTED INSTRUCTION TIME: 1 Hour

RELATED TECHNICAL INFORMATION:

- Observe safety precautions removing and installing tire on rim.
- Observe proper techniques of using air wrench.
- When inflating tire, do not exceed 40 psi.
- Check for leaks.

UNIT 9.0 WHEELS AND TIRES - LEVEL I

TASK 9.02 REPAIR FLAT TIRE

---

PERFORMANCE OBJECTIVE:

Given an automobile with a flat tire, repair the tire by removing it from the rim, repairing the leak as appropriate, and remounting the tire on the rim according to manufacturer's recommendations.

PERFORMANCE ACTIONS:

9.0201 Remove tire and rim assembly from vehicle.

9.0202 Release air from tire, using valve tool.

9.0203 Position tire and break bead using proper tools and following proper procedures. (Recommendation: Start with valve side down if applicable.)

9.0204 Turn tire over and break bead, if both sides not broken in above operation.

9.0205 Repair tire following manufacturer's recommendations.

9.0206 Examine tire condition carefully.

9.0207 Examine rim for damage.

9.0208 Inspect seal of valve.

9.0209 Replace tire on rim.

9.0210 Remove valve core from mounted tire.

9.0211 Take necessary safety precautions. Inflate tire forcing tire beads outward and sealing to rim.

9.0212 Replace valve core and inflate tire to specified pressure.

PERFORMANCE STANDARDS:

- Given an automobile tire needing repair, remove and repair the tire and replace it inflated to specifications.
- The repaired tire must meet standards of the industry or instructor.
- The repair must be safe.
- There must be no leaks.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 9.0 WHEELS AND TIRES - LEVEL I

TASK 9.03 RECOGNIZE BOTH CAUSES AND REMEDIES OF ABNORMAL TIRE WEAR

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PERFORMANCE OBJECTIVE:

On a given automobile, inspect the tire casting and tread for wear and damage in accordance with given specification.

PERFORMANCE ACTIONS:

9.0301 Raise car on hoist or raise wheel off ground and install safety stand.

9.0302 Check air pressure.

9.0303 Adjust tire pressure as necessary.

9.0304 Check tread depth. Tread depth should be no less than 1/16 inch. If less, the tire should be replaced.

9.0305 Inspect tread face for abnormal tire wear:

| | Wear Symptoms | | Possible Cause |
|---|---|---|---|
| a. | Worn shoulders | a. | Low inflation, rotation of radials |
| b. | Worn center | b. | Over inflation |
| c. | Flat spots on outside edges | c. | Wheel out of balance |
| d. | Flat spots on inner ribs | d. | Incorrect camber adjustments, defective shock absorbers, or loose front end parts |
| e. | Feathered edges on all ribs | e. | Excessive toe-in or toe-out |

9.0306 Spin tire slowly, inspecting sidewalls for abrasions, scuffing, and other tire damage.

9.0307 Spin tire slowly, inspecting groove between ribs for cracks (stretching or casing).

9.0308 Inspect tread face for cuts (primarily on sides).

9.0309 Test cuts with soap solution, if appropriate. Do not repair cuts, replace tire.

PERFORMANCE ACTIONS (Con't.):

9.0310 Inspect tread and sidewall for bubbles and buldges (separation of tread from casing). If found, replace tire.

9.0311 Lower automobile close to floor. Spin tire and check for roundness (with radial run-out gauge or using a shop improvised method).

(NOTE: If tire passes inspection, check specifications and balance of tire.)

PERFORMANCE STANDARDS:

- On a given automobile, inspect the tire casing and tread to ensure that the tire meets acceptable industry standards for wear and safety. Meet instructor's standards of performance.

SUGGESTED INSTRUCTION TIME: 1 Hour

UNIT 9.0 WHEELS AND TIRES - LEVEL II

TASK 9.04 PERFORM FRONT WHEEL BEARING SERVICES, REMOVE, CLEAN, LUBRICATE, REPLACE, AND ADJUST

---

PERFORMANCE OBJECTIVE:

Given a vehicle, wheel bearing lubricant, proper tools, and service manual; repack the inner and outer front wheel bearings following the manufacturer's specifications and procedures, adjust the front bearings to meet the manufacturer's specifications.

PERFORMANCE ACTIONS:

9.0401 Raise front of vehicle and use safety stands.

9.0402 Remove front wheel assemblies and inner wheel bearings.

9.0403 Clean inner and outer wheel bearings following accepted practices. Inspect bearings. Replace wheel bearings lubricant with proper type.

9.0404 Install inner wheel bearings, grease seals, and install wheel assemblies on vehicle.

9.0405 Install outer wheel bearings and spindle nut.

9.0406 Adjust wheel bearings following manufacturer's procedures and specifications.

9.0407 Install new cotter pins, dust, and hub caps.

PERFORMANCE STANDARDS:

- Repack the inner and outer front wheel bearings on a vehicle provided by the instructor. Adjust to manufacturer's specifications.
- Bearing lubricant should meet manufacturer's recommendations.

SUGGESTED INSTRUCTION TIME: 4 Hours

RELATED TECHNICAL INFORMATION:

- Use clean surface or paper which to place bearings and parts.
- Clean bearings before installation and regreasing.
- Never let grease get on the brake drums.

(NOTE: See Task 10.11, Steering and Suspension for more detail.)

| | | |
|---|---|---|
| UNIT | 9.0 | WHEELS AND TIRES - LEVEL II |
| TASK | 9.05 | SPEED BALANCE WHEELS AND TIRES |

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PERFORMANCE OBJECTIVE:

Given an automobile with unbalanced wheels, wheel weights, and access to a service manual and the proper tools and equipment; balance the wheels and tires following the manufacturer's procedures.

PERFORMANCE ACTIONS:

9.0501 Raise vehicle from floor, supporting vehicle to use balancing equipment.

9.0502 Prepare wheel and tire for balancing. (air pressure, inspect for cuts, remove gravel, remove old wheel weights)

9.0503 Balance wheels following equipment operating manual procedures.

9.0504 Check wheel weights for secure installation.

PERFORMANCE STANDARDS:

- Balance the wheels on a given automobile to balancing equipment operating manual procedures.

SUGGESTED INSTRUCTION TIME: 4 Hours

RELATED TECHNICAL INFORMATION:

- Identify "static" and "dynamic" type balancing. Advantages of each.

UNIT 9.0 WHEELS AND TIRES - LEVEL II

TASK 9.06 (Diagnostic Task) DIAGNOSE TIRE AND WHEEL MALFUNCTIONS

---

PERFORMANCE OBJECTIVE:

Given an automobile, check the tires and wheels and report any malfunctions with recommendations on correcting malfunctions that cannot be corrected by typical service such as adding or reducing air pressure. Finding recommendations must agree with the instructor's findings.

PERFORMANCE ACTIONS:

9.0601 Inspect the tire and wheel rim assembly.
  (a) Check for tire damage
  (b) Check for wheel damage

9.0602 Check air pressure in tire.

9.0603 Check tire tread wear patterns.

9.0604 Check the balance of the tires.

9.0605 Rotate tires, if necessary/requested.

PERFORMANCE STANDARDS:

- Diagnose tire and wheel malfunctions on a given automobile.

SUGGESTED INSTRUCTION TIME: 2 Hours

RELATED TECHNICAL INFORMATION:

- See manufacturer's specifications on type or tires for rotation.
- Remove wheel assembly and replace assembly.
- Inspect for runout.

# TASK LISTINGS
## AUTOMOTIVE MECHANICS

| UNIT/TASK | DESCRIPTION |
|---|---|
| Unit 10.0 | STEERING AND SUSPENSION |
| 10.01 | (Lubricate Front and Rear Suspension) Given a vehicle, service manual, lubrication equipment, and the proper tools; lubricate the front and rear suspension components as described by the manufacturer's procedures and specifications. |
| 10.02 | (Replace Belts and Adjust Tension) Given a vehicle, replacement belts, and access to the appropriate tools, equipment, and service manual; replace the alternator/generator, and power steering belts and adjust them the tension recommended by the manufacturer. |
| 10.03 | (Check and Correct Power-Steering System Fluid Level and Belt Tension) Given a vehicle with power steering, check the power-steering fluid level and belt-tension and fill the fluid level as required with manufacturer's recommended lubricant. |
| 10.04 | (Inspect Steering Linkage and Ball-Joints) Given a vehicle, service manual, and access to the necessary tools and equipment; lubricate the upper and lower ball-joints following the manufacturer's procedures and specifications. |
| 10.05 | (Replace Tie Rod End [Ball Socket]) Given an automobile with tie rod end (ball socket) wear, proper tools and equipment, and replacement parts, and service data; remove and replace tie rod ends as needed. |
| 10.06 | (Replace Idler Arm) Given an automobile with a loose idler arm, necessary tools, equipment, replacement parts, and service manual; remove and replace the idler arm. |
| 10.07 | (Remove and Replace Shock Absorbers) Given a vehicle, service manual, and necessary tools and parts; remove and replace shock absorbers. |
| 10.08 | (Remove and Replace McPherson Strut Assembly) Given a vehicle, service manual, and proper tools, remove and replace the McPherson strut assembly. All attachment hardware must be torqued to specifications, right height must be correct, and wheels must turn to extremes without binding. |

10.09 (Perform Visual Inspections of Suspension System) Given a vehicle with improper suspension action, visually inspect the front and rear suspension components and vehicle sag conditions as outlined in the manufacturer's procedures. All worn components identified by the instructor must be recognized.

10.10 (Inspect and Service Front Wheel Bearing and Grease Seal) Given a vehicle, service manual, and necessary tools, grease, and replacement seal; inspect and service the wheel bearing and seal. When completed, the quantity of grease in bearing will be checked, the direction that the seal is installed will be noted, and proper wheel bearing adjustment will be observed.

10.11 (Inspect and Diagnose Steering and Front Suspension System Problems) Given a vehicle with known defective steering or suspension components, a service manual, and using the proper tools and equipment; inspect and diagnose the cause of the problem and identify the probable repair to meet manufacturer's specifications and for the vehicle to operate properly.

10.12 (Replace Coil Springs) Given vehicle service manual, proper tools and equipment; remove and replace the coil spring(s). When completed, the springs must be properly seated.

10.13 (Remove and Replace Leaf Springs) Given vehicle, service manual, proper tools; remove and replace leaf springs. When completed, the springs should allow for the correct curb heights. All nuts and U-bolts should be secure.

10.14 (Adjust Worm and Sector in Steering Gear) Given a vehicle, access to proper tools, equipment, and service manual; adjust worm gear end play and hi-point in accordance with manufacturer's procedures and specifications.

10.15 (Repair or Replace Manual Steering Components) Given a malfunctioning manual steering gear, appropriate replacement parts, and proper tools, equipment, and service manual; replace defective steering gear components following manufacturer's procedures and specifications.

10.16 (Replace Power Steering Components) Given an automobile with a known defective power steering component, and access to proper tools, equipment, and service manual; locate the defect and remove and replace defective component in accordance with manufacturer's specifications and procedures.

10.17 (Repair Tilt and Telescoping Steering Wheel) Using the appropriate tools and equipment, and following the manufacturer's procedures and specifications; disassemble and repair the malfunctioning tilt and telescoping steering wheel in a given automobile.

10.18 (Inspect Front Suspension System) Given an automobile, visually inspect the front suspension system for worn or damaged parts and report the findings. Findings must agree with the instructor's findings.

10.19 (Rebush King Pins) Given a vehicle with defective king pins, and access to proper tools, equipment, and service manual; rebush king pins as prescribed by manufacturer's procedures and specifications.

10.20 (Replace Ball-Joints) Given a vehicle, and access to a service manual, replacement ball-joints, and proper tools and equipment; replace upper and lower ball-joints according to manufacturer's procedures and specifications.

10.21 (Replace Front Suspension Control Arms and Bushings) Given a vehicle and the appropriate replacement parts, and using the proper tools, equipment, and service manual; replace the front suspension control arms and bushings as prescribed by manufacturer's procedures and specifications.

10.22A (Adjust Torsion Bars) Given a vehicle with maladjusted torsion bars, and using appropriate tools, equipment, and service manual; adjust the torsion bars, following the manufacturer's procedures and specifications.

10.22B (Replace Torsion Bars) Given vehicle with torsion bars, access to appropriate tools, equipment, and service manual; remove and replace torsion bars according to manufacturer's procedures and specifications.

10.23 (Balance Wheels and Tires) Given a wheel and tire assembly, wheel balancer, and proper tools and wheel weights, balance the assembly.

10.24 (Remove and Replace Steering Spindle [Ball-Joint Type]) Given a vehicle, service manual, and proper tools; remove and replace the steering spindle. When completed, all attaching bolts and cotter pins will be checked for security.

10.25 (Inspect and Align Front End) Given a vehicle with the front end out of alignment, and access to a service manual, special tools, and equipment; check the wheel alignment angles and align the front wheel following the manufacturer's specifications and procedures.

10.26 (Inspect and Service Rear End) On a given automobile known defects, manufacturer's service manual, necessary tools and equipment; inspect and service the rear end suspension.

TASK 10.01 LUBRICATE FRONT AND REAR SUSPENSION

---

PERFORMANCE OBJECTIVE:

Given a vehicle, service manual, lubrication equipment, and the proper tools; lubricate the front and rear suspension component (including ball-joints) as described by the manufacturer's procedures and specifications.

PERFORMANCE ACTIONS:

10.0101 Raise vehicle from floor and support it with safety stands.

10.0102 Clean all lubrication zerk fittings of the steering and suspension components.

10.0103 If joints not fitted with zerk fittings and, if it is appropriate, install zerk fittings.

10.0104 Lubricate ball-joints using recommended chassis lube.

10.0105 Using recommended chassis lube, lubricate all front and rear suspension components as required.

PERFORMANCE STANDARDS:

- Lubricate the front and rear suspension components on an automobile provided by the instructor.

SUGGESTED INSTRUCTION TIME: 2 Hours

RELATED TECHNICAL INFORMATION:

- Check with instructor concerning proper amount of grease lubricant.

UNIT 10.0 STEERING AND SUSPENSION - LEVEL I

TASK 10.02 REPLACE BELTS AND ADJUST TENSION

---

PERFORMANCE OBJECTIVE:

Given a vehicle, replacement belts, and access to the appropriate tools, equipment, and service manual; replace the alternator/generator, and power steering belts and adjust them the tension recommended by the manufacturer.

PERFORMANCE ACTIONS:

10.0201 Refer to vehicle manufacturer's manual for belt removal and replacement procedures and belt tension specifications.

10.0202 Loosen alternator/generator, power steering adjusting locking bolts.*

10.0203 Install belts and adjust to proper tension.

10.0204 Be sure component locking belts are secure.

PERFORMANCE STANDARDS:

- Replace belts and adjust them to specified tension on a given automobile.
- Meet manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 1 Hour (Minimum)*

RELATED TECHNICAL INFORMATION:

- *May require replacement of air conditioner and air pump belts on some vehicles.

UNIT 10.0 STEERING AND SUSPENSION - LEVEL I

TASK 10.03 CHECK AND CORRECT POWER-STEERING SYSTEM FLUID LEVEL AND BELT TENSION

---

PERFORMANCE OBJECTIVE:

Given a vehicle with power steering, check the power-steering fluid level and belt-tension and fill the level as required with manufacturer's recommended lubricant.

PERFORMANCE ACTIONS:

10.0301 Check tire pressure, a cause of hard steering.

10.0302 Check drive belt condition and tension. Use a belt-tension gauge to determine if the belt is to manufacturer's specifications. Examine for glaze that might cause slipping. If the belt is noisy, spray an appropriate lubricant to reduce the noise.

10.0303 Check the power-steering fluid level. Fluid level should be measured with the motor at operating temperature.

- a. Wipe area around reservoir cap and remove cap.
- b. Check fluid level on dipstick.
- c. If there is no dipstick, wheel the steering to full left and full right and observe the fluid come to halfway up the filler neck. If it is less than halfway, add fluid as appropriate.

10.0304 Inspect for leaks.

PERFORMANCE STANDARDS:

- Check and correct power-steering fluid level and belt tension as necessary to meet manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 10.04 STEERING AND SUSPENSION - LEVEL II

TASK 10.04 INSPECT STEERING LINKAGE AND BALL-JOINTS

---

PERFORMANCE OBJECTIVE:

On a given automobile, using the proper tools, equipment, and service manual; inspect the steering linkage for wear. Determine if the linkage is within the tolerances specified by the manufacturer.

PERFORMANCE ACTIONS:

10.0401 Raise vehicle so that front wheels are off floor and suspension is supported under outer ends of lower control arms.

10.0402 Starting with left front wheel, shake front wheels (side-to-side) and check for loose steering linkage components. (Steering arms, tie rod ends, relay rod, pitman arm, idler arm, and steering gear-to-frame mounting.)

10.0403 Starting with either wheel.

10.0404 Grab the wheel and shake it in and out and note play in ball-joint.

10.0405 Also, push directly up on wheel and look for play in ball-joint.

10.0406 Move to opposite wheel and perform same tasks.

10.0407 Check manufacturer's service manual to determine if linkage tolerance and ball-joint tolerance is within specifications.

PERFORMANCE STANDARDS:

- Inspect steering linkage and ball-joints on vehicle provided and determine if linkage is within manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 1 Hour

UNIT 10.0 STEERING AND SUSPENSION - LEVEL II

TASK 10.05 REPLACE TIE ROD END (BALL SOCKET)

---

PERFORMANCE OBJECTIVE:

Given an automobile with tie rod end (ball socket) wear, proper tools and equipment, and replacement parts, and service data; remove and replace tie rod ends as needed.

PERFORMANCE ACTIONS:

10.0501 Inspect tie rod ends for wear.

10.0502 Remove cotter pin and retaining nut.

10.0503 If the tie rod end is worn and will be discarded, it may be removed with tools. A air-driven chisel or a puller may be used. (NOTE)

10.0504 To install the new tie rod stud, clean the stud and the tapered hole into which it fits. Wipe stud with thin coat of oil.

10.0505 Insert stud and run retaining nut up. Torque to specifications.

10.0506 Supporting the steering arm with a block of steel, rap arm sharply several times with hammer. Retorque, insert cotter pin, and bend ends open.

PERFORMANCE STANDARDS:

- Inspect and replace tie rod end (ball socket) on a given automobile to meet manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 1 Hour

(NOTE: Count number of turns necessary to remove the rod end and insert new tie rods by turning it the same number of turns.)

| | | |
|---|---|---|
| UNIT | 10.0 | STEERING AND SUSPENSION - LEVEL II |
| TASK | 10.06 | REPLACE IDLER ARM |

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PERFORMANCE OBJECTIVE:

Given an automobile with a loose idler arm, necessary tools, equipment, replacement parts, and service manual; remove and replace the idler arm.

PERFORMANCE ACTIONS:

10.0601 Inspect idler arm for wear. Determine if the manufacturer recommends replacing the idler arm or allows new bushings or bearings to be inserted.

10.0602 Remove the old bushing and insert a new one from the replacement kit. (If replacing new bushing is allowed.)

10.0603 If new idler arm is required, install the part.

10.0604 Torque all idler arm fasteners. Install cotter pins. Check for binding. Lubricate if required.

PERFORMANCE STANDARDS:

- Inspect, remove, and replace a loose idler arm on a given vehicle (or replace worn bushing if allowed).
- Repaired idler arm should be torqued and should not be loose.

SUGGESTED INSTRUCTION TIME: 1 Hour

UNIT 10.0 STEERING AND SUSPENSION - LEVEL II

TASK 10.07 REMOVE AND REPLACE SHOCK ABSORBERS

---

PERFORMANCE OBJECTIVE:

Given a vehicle, service manual, and necessary tools and parts; remove and replace shock absorbers.

PERFORMANCE ACTIONS:

10.0701 Raise vehicle from floor and support it according to safety practices.

10.0702 Using proper tools, remove shock absorber upper mounting nuts and locks.

10.0703 Remove lower mounting bolts/nuts. Withdraw shock absorbers from vehicle.

10.0704 Install new shock absorbers and rubber bushings following reverse order. Tighten attaching bolts and nuts to proper specifications.

PERFORMANCE STANDARDS:

- Remove and replace shock absorbers. When completed, shock bolts will be checked for tightness.

SUGGESTED INSTRUCTION TIME: 2 Hours (per pair)

RELATED TECHNICAL INFORMATION:

- Safety precautions when working under a raised vehicle.
- Proper torque of shock absorber rubber gromets when used.
- Demonstrate test for operation and noise of shock absorbers.

UNIT 10.0 STEERING AND SUSPENSION - LEVEL II

TASK 10.08 REMOVE AND REPLACE MCPHERSON STRUT ASSEMBLY

---

PERFORMANCE OBJECTIVE:

Given a vehicle, service manual, and proper tools; remove and replace the McPherson strut assembly. All attachment hardware must be torqued to specifications, height must be correct, and wheels must turn to extremes without binding.

PERFORMANCE ACTIONS:

10.0801 Remove:

a. Loosen the wheel lug nuts (bolts), raise the front of vehicle, and support it safely. Remove the wheel.
b. Disconnect the flexible brake hose and plug the end to prevent fluid loss, (if necessary).
c. Disconnect strut assembly from lower ball-joint or spindle carrier.
d. Remove top mounting bolts of strut assembly and remove the suspension strut assembly from the vehicle.

10.0802 Disassembly:

a. Put strut assembly in vise, install a spring compressor tool to the coil spring to relieve the tension from the top mount assembly.
b. Remove the top mount retaining nut while holding the top of the piston rod with an allen wrench in the socket provided.
c. Dissemble the top mount assembly and separate the spring from the strut assembly. (CAUTION: The spring will be under much more tension than normal while the compressor tool is in place. If the spring is not to be replaced and the compressor tool is left on the spring, locate the spring in a safe place until ready for use.)
d. Remove strut piston rod to housing nut, pull piston rod and seals or cartridge out of housing.
e. Turn housing over and draw out any oil that is in housing.
f. Install new strut cartridge in housing and reassemble and install on car in reverse order.
g. Torque all bolts to specifications.

TASK 10.08 REMOVE AND REPLACE MCPHERSON STRUT ASSEMBLY

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PERFORMANCE ACTIONS (Con't.):

h. Align front end and road test.
(NOTE: Refer to manufacturing specifications for special instructions on each application.)

PERFORMANCE STANDARDS:

- Remove and replace McPherson strut assembly.
- Replaced assembly must be torqued to manufacturer's specifications, height adjustment must be correct, and wheels must turn to extremes without binding.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 10.0 STEERING AND SUSPENSION - LEVEL II

TASK 10.09 PERFORM VISUAL INSPECTIONS OF SUSPENSION SYSTEM

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## PERFORMANCE OBJECTIVE:

Given a vehicle with improper suspension action, visually inspect the front and rear suspension components and vehicle sag conditions as outlined in the manufacturer's procedures. All worn components identified by the instructor must be recognized.

## PERFORMANCE ACTIONS:

10.0901 Raise vehicle to proper working height to allow visual inspections of the front suspension components.

10.0902 Note and record any suspension parts that show any obvious defects, such as balljoint dust boots worn, control arm bushing or other bent, loose, or worn parts.

## PERFORMANCE STANDARDS:

- On an instructor provided vehicle with visual signs of suspension problems, inspect the suspension components and tell the instructor which components need repair or replacement.

SUGGESTED INSTRUCTION TIME: 1 Hour

UNIT 10.0 STEERING AND SUSPENSION - LEVEL II

TASK 10.10 INSPECT AND SERVICE FRONT WHEEL BEARING AND GREASE SEAL

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PERFORMANCE OBJECTIVE:

Given a vehicle, service manual, and necessary tools, grease, and replacement seal; inspect and service the wheel bearing and seal. When completed, the quantity of grease in bearing will be checked, the direction that the seal is installed will be noted, and proper wheel bearing adjustment will be observed.

PERFORMANCE ACTIONS:

10.1001 Remove front wheel.

10.1002 Remove bearing dust cap.

10.1003 Straighten cotter pin and remove.

10.1004 Unscrew adjusting nut.

10.1005 Remove pronged safety thrust washer.

10.1006 Shake wheel from side to side, pulling wheel outward and wobbling it to remove outer bearing from hub.

10.1007 Remove outer bearing and place it in clean container.

10.1008 Pull wheel straight off spindle. (Avoid dragging rear bearing across spindle threads.)

10.1009 Lay wheel over clean material, engage rear bearing cone (not cage), tap inner bearing from hub. If necessary, use a special seal puller.

10.1010 Discard grease seal (new seal to be installed).

10.1011 Clean bearings and rinse in clean solvent. (Discard bearings showing slightest signs of wear or damage.)

10.1012 Clean and flush out inside of hub.

10.1013 Pack each bearing full of grease.
(NOTE: Greases containing Lithium or Sodium soaps should not be mixed.)

10.1014 Bearings must be clean and dry before packing.

| | | |
|---|---|---|
| UNIT | 10.0 | STEERING AND SUSPENSION - LEVEL II |
| TASK | 10.10 | INSPECT AND SERVICE FRONT WHEEL BEARING AND GREASE SEAL (Con't.) |

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PERFORMANCE STANDARDS:

- Inspect and service wheel bearing and seal, replacing seal.
- When completed, grease in bearing is proper type and level, and bearing adjustment must be within specifications of manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 4 Hours

RELATED TECHNICAL INFORMATION:

- Observe safety precautions of working under raised vehicle.
- Proper removal, cleaning, and grease packing of front wheel spindle bearings.

| | | |
|---|---|---|
| UNIT | 10.0 | STEERING AND SUSPENSION - LEVEL III |
| TASK | 10.11 | INSPECT AND DIAGNOSE STEERING AND FRONT SUSPENSION SYSTEM PROBLEMS |

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PERFORMANCE OBJECTIVE:

Given a vehicle with known defective steering or suspension components, a service manual, and using the proper tools and equipment; inspect and diagnose the cause of the problem and identify the probable repair to meet manufacturer's specifications and for the vehicle to operate properly.

PERFORMANCE ACTIONS:

10.1101 Raise front of vehicle, follow accepted safety practices.

10.1102 Check steering and front suspension systems for worn or loose parts.

10.1103 Diagnose the repair procedures and the components needing attention.

PERFORMANCE STANDARDS:

- On an instructor provided automobile, identify the defective steering and front suspension problems and diagnose the necessary repairs and replacements that will result in proper operation of the vehicle, meeting manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 1 Hour

TASK 10.12 REPLACE COIL SPRINGS

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PERFORMANCE OBJECTIVE:

Given vehicle, service manual, proper tools and equipment; remove and replace the coil spring(s). When completed, the springs must be properly seated.

PERFORMANCE ACTIONS:

10.1201 Raise car. Place safety jacks, if appropriate.

10.1202 Remove wheel and tire assembly.

10.1203 Disconnect stabilizer bar. (From side coil is being removed.)

10.1204 Remove shock absorber.

10.1205 Disconnect lower arm tie strut, if applicable.

10.1206 Attach safety chain to prevent spring from flying out.

10.1207 Place jack under lower arm.
(NOTE: "Place jack as near parallel to length of arm as possible to allow jack to move forward or backward to follow the movement of the suspension arm free end.")

10.1208 Remove lower balljoint stud as recommended under balljoint removal.

10.1209 Lower jack until lower suspension arm removes pressure from spring.
(NOTE: SPRING UNDER PRESSURE MAY FLY OUT!)

10.1210 Remove spring.

10.1211 Replace spring by reversing procedures.
(NOTE: Specifications concerning spring end location and placement of spring insulators.)

UNIT 10.0 STEERING AND SUSPENSION - LEVEL III

TASK 10.12 REPLACE COIL SPRINGS

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PERFORMANCE ACTIONS (Con't.):

10.1212 Raise arm until ball-joint stud passes through spindle body. Install stud nut, torque and insert cotter pin. As arm is raised, do not allow spring to rotate from proper position.

10.1213 Install shock absorber, stabilizer bar and tie strut as appropriate.

PERFORMANCE STANDARDS:

- Remove and replace (front) coil springs meeting manufacturer's specifications and observing safety procedures.

SUGGESTED INSTRUCTION TIME: 5 Hours

RELATED TECHNICAL INFORMATION:

- Observe proper safety procedures.

UNIT 10.0 STEERING AND SUSPENSION - LEVEL III

TASK 10.13 REMOVE AND REPLACE LEAF SPRINGS

---

## PERFORMANCE OBJECTIVE:

Given vehicle, service manual, proper tools; remove and replace leaf springs. When completed, the springs should allow for the correct curb heights. All nuts and U-bolts should be secure.

## PERFORMANCE ACTIONS:

10.1301 To remove leaf spring, refer to manufacturer's manual for proper procedures.

10.1302 Remove leaf spring bushings using a puller if necessary.

10.1303 Clean spring eye thoroughly and coat it with a suitable lubricant prior to pulling new bushing in place.

10.1304 Allow weight of vehicle to rest on bushings before torquing shackle bolts. (Vehicle should be at curb height before tightening bolts to prevent damage to bushings.)

10.1305 Replace any broken spring leaves. Where required, use inserts between spring leaves. Tighten spring center bolt. Torque spring U-bolts.

10.1306 All spring rebound clips must be in place.

10.1307 Check rear standing or curb height.

## PERFORMANCE STANDARDS:

- Remove and replace rear leaf spring(s) on a given vehicle according to manufacturer's procedures and meeting manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 6 Hours

UNIT 10.0 STEERING AND SUSPENSION - LEVEL III

TASK 10.14 ADJUST WORM AND SECTOR IN STEERING GEAR

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PERFORMANCE OBJECTIVE:

Given a vehicle, access to proper tools, equipment, and service manual; adjust worm gear end play and hi-point in accordance with manufacturer's procedures and specifications.

PERFORMANCE ACTIONS:

10.1401 Raise vehicle off floor.

10.1402 Disconnect steering linkage or pitman arm.

10.1403 Turn steering wheel to extreme travel and check worm gear end play.

10.1404 Raise hood and place fender covers.

10.1405 Adjust worm gear end play in accordance with manufacturer's recommended tolerances.

10.1406 Center steering.

10.1407 Adjust cross shaft adjustment screw to meeting manufacturer's specifications (Hi-point).

10.1408 Re-tighten lock nut.

10.1409 Check and fill steering gear to proper fluid level.

10.1410 Reconnect steering linkage or pitman arm.

10.1411 Road test for performance.

PERFORMANCE STANDARDS:

- Adjust worm gear end play and hi-point in vehicle provided by instructor.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 10.0 STEERING AND SUSPENSION - LEVEL III

TASK 10.15 REPAIR OR REPLACE MANUAL STEERING COMPONENTS

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PERFORMANCE OBJECTIVE:

Given a malfunctioning manual steering gear, appropriate replacement parts, and proper tools, equipment, and service manual; replace defective steering gear components following manufacturer's procedures and specifications.

PERFORMANCE ACTIONS:

10.1501 Refer to manufacturer's manual steering gear, disassembly/assembly procedures and adjustment specifications.

10.1502 Drain lube from steering gear.

10.1503 Remove cross shaft.

10.1504 Remove tube and worm gear.

10.1505 Remove and replace cross shaft bushing and seals (hone bushings to fit cross shaft, if necessary).

10.1506 Install worm bearings and tube and worm gear. Adjust end play.

10.1507 Install cross shaft and adjust hi-point.

10.1508 Refill steering gear with lubricant to specifications.

PERFORMANCE STANDARDS:

- Replace defective steering gear components in vehicle provided by instructor.

SUGGESTED INSTRUCTION TIME: 10 Hours*

*NOTE: Typical time estimated for average defective component to be replaced.

UNIT 10.0 STEERING AND SUSPENSION - LEVEL III

TASK 10.16 REPLACE POWER STEERING COMPONENTS

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## PERFORMANCE OBJECTIVE:

Given an automobile with a known defective power steering component, and access to proper tools, equipment, and service manual; locate the defect and remove and replace defective component in accordance with manufacturer's specifications and procedures.

## PERFORMANCE ACTIONS:

10.1601 Visually inspect all steering components for leaks, physical damage or looseness.

10.1602 Check belt tension, oil level in power steering pump, check steering actions, and check oil pressure in power steering system.

10.1603 Locate defective components.

10.1604 Replace according to manufacturer's suggested procedures.

10.1605 Operate and check for correction operation.

## PERFORMANCE STANDARDS:

- Remove and replace the defective power steering component on a vehicle provided by the instructor.

SUGGESTED INSTRUCTION TIME: 1 Hour (estimated for replace and repair power steering hose)*

* Depends on defective components, component used (hose) typically is one of first in system to become defective.

UNIT 10.0 STEERING AND SUSPENSION - LEVEL III

TASK 10.17 (Optional) REPAIR TILT AND TELESCOPING STEERING WHEEL

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PERFORMANCE OBJECTIVE:

Using the appropriate tools and equipment, and following the manufacturer's procedures and specifications; disassemble and repair the malfunctioning tilt and telescoping steering wheel in a given automobile.

PERFORMANCE ACTIONS:

10.1701 Disconnect transmission control rods and flex coupling.

10.1702 Disconnect electrical connections and remove steering column trim cover and transmission selector cable.

10.1703 Remove toe plate nuts.

10.1704 Disconnect upper column and remove.

10.1705 Examine for worn, loose, or broken parts and replace if necessary.

10.1706 Reassemble in reverse order.

PERFORMANCE STANDARDS:

- On an instructor provided vehicle with a malfunctioning tilt and telescoping steering wheel, disassemble and repair the components of the steering wheel that are causing the problem.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 10.0 STEERING AND SUSPENSION - LEVEL III

TASK 10.18 INSPECT FRONT SUSPENSION SYSTEM

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PERFORMANCE OBJECTIVE:

Given an automobile, visually inspect the front suspension system for worn or damaged parts and report the findings. Findings must agree with the instructor's findings.

PERFORMANCE ACTIONS:

10.1801 Make a note of customer's complaints.

10.1802 Check shock absorbers by bouncing the car.

10.1803 Raise the front of the car.

10.1804 Use safety stands if the car is not on a lift.

10.1805 Check the wheel bearing adjustment by shaking the wheel at the top and bottom to ensure that there is no play or slack.

10.1806 Spin the wheel. The wheel should spin free and there should be no noise.

10.1807 (Check manufacturer's specifications) If applicable, grasp the tire firmly at the front and rear. Shake it. If looseness if felt, check the underside of the wheel to determine the location problem.

10.1808 Under the car, check the Idler Arm thoroughly, visually and by shaking it by hand. (Generally, the Idler Arm assembly will need repair or replacemement on the majority of cars.)

10.1809 Check all parts of the front suspension system both visually and by hand for loose parts, loose bolts, or mounting--worn rubber bushings, power steering oil leaks, bent parts, etc. Check to see that the steering gear is bolted securely to the frame.

10.1810 Check all tires for condition. Signs of excessive wearing, flat sponts, air pressure, cuts, etc.

10.1811 Remove safety stands. Lower car to floor.

PERFORMANCE ACTIONS (Con't.):

10.1812 Place jack under right hand lower control arm, as close to the wheel as possible. Raise the car until the tire is 2-4 inches above the floor. Place safety stand under the frame of the car but leave the jack supporting the weight of the car.

10.1813 Grasp the wheel firmly and shake it noting any play or looseness. Pry the tire up and down.

10.1814 Repeat steps 12 and 13 on the opposite side of the car.

10.1815 Remove stand, lower car, put tools away. Report findings.

PERFORMANCE STANDARDS:

- Visually inspect the front suspension system for worn or damaged parts.

SUGGESTED INSTRUCTION TIME: 4 Hours

RELATED TECHNICAL INFORMATION:

- Types and characteristics of front end systems.

UNIT 10.0 STEERING AND SUSPENSION - LEVEL III

TASK 10.19 REBUSH KING PINS

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PERFORMANCE OBJECTIVE:

Given a vehicle with defective king pins, and access to proper tools, equipment, and service manual; rebush king pins as prescribed by manufacturer's procedures and specifications.

PERFORMANCE ACTIONS:

10.1901 Raise front of vehicle and support vehicle following accepted safety practices.

10.1902 Remove front wheel assemblies and brake backing plates from steering knuckles.

10.1903 Remove king pin locking pins and upper and lower dust/grease cups, snap rings, etc.

10.1904 Drive out king pins and separate steering knuckle from axle eye.

10.1905 Rebush steering knuckles and hone to fit new king pins, if required.

10.1906 Install steering knuckles and new king pins on vehicle.

10.1907 Install locking pins, grease cups and snap rings.

10.1908 Install brake backing plates to steering knuckles and reinstall front wheel assemblies.

10.1909 Lubricate new king pins and busings.

PERFORMANCE STANDARDS:

- On instructor provided vehicle with defective king pins in steering system, rebush king pins and reinstall them into vehicle.

SUGGESTED INSTRUCTION TIME: 4 Hours (per side)

UNIT 10.0 STEERING AND SUSPENSION - LEVEL III

TASK 10.20 REPLACE BALL-JOINTS

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PERFORMANCE OBJECTIVE:

Given a vehicle, and access to a service manual, replacement ball-joints, and proper tools and equipment; replace upper and lower balljoints according to manufacturer's procedures and specifications.

PERFORMANCE ACTIONS:

10.2001 Raise front of vehicle from floor and use safety jacks or proper safety procedures.

10.2002 Remove front wheel assemblies.

10.2003 With jack support located outboard under lower control arm, remove cotter pins and ball-joint stud nuts.

10.2004 Separate ball-joints from spindle support arms using proper tools and equipment.

10.2005 Remove ball-joints from control arms using proper tools and equipment.

10.2006 Using proper tools and equipment, install new ball-joints to control arms.

10.2007 Attach ball-joints to spindle support arm and tighten to proper torque specifications.

10.2008 Lubricate new ball-joints and reinstall wheel assemblies.

10.2009 Check for wheel alignment.

PERFORMANCE STANDARDS:

- Replace upper and lower ball-joints on vehicle provided by instructor.

SUGGESTED INSTRUCTION TIME: 6 Hours (per side)

TASK 10.21 REPLACE FRONT SUSPENSION CONTROL ARMS AND BUSHINGS

---

PERFORMANCE OBJECTIVE:

Given a vehicle and the appropriate replacement parts, and using the proper tools, equipment, and service manual; replace the front suspension control arms and bushings as prescribed by manufacturer's procedures and specifications.

PERFORMANCE ACTIONS:

| | |
|---|---|
| 10.2101 | Raise vehicle from floor and support vehicle according to safety practices. |
| 10.2102 | Remove front wheel assemblies. |
| 10.2103 | With support jack located outboard under lower control arms, disconnect lower ball-joints from spindle-support arms. Disconnect shock absorbers, strut rods, stabilizer bar links. |
| 10.2104 | Remove coil springs, if equipped. |
| 10.2105 | Remove lower control arm and replace inner bushings. |
| 10.2106 | Reinstall lower control arms and coil springs, if required. |
| 10.2107 | Disconnect upper ball-joints from spindle support arms. |
| 10.2108 | Remove upper control arms and replace inner bushings. |
| 10.2109 | Reinstall upper control arms and reconnect ball-joints to spindle support arms. |
| 10.2110 | Install front wheel assemblies. |

PERFORMANCE STANDARDS:

- Replace front suspension control arms and bushings on vehicle provided by instructor.

SUGGESTED INSTRUCTION TIME: 10 Hours (one side upper and lower)*

*Time will depend on type of vehicle.

TASK 10.22A ADJUST TORSION BARS

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PERFORMANCE OBJECTIVE:

Given a vehicle with maladjusted torsion bars, and using appropriate tools, equipment, and service manual; adjust the torsion bars, following the manufacturer's procedures and specifications.

PERFORMANCE ACTIONS:

10.2201 With vehicle on level surface, install torsion bar height gauges on lower control arms.

10.2202 Adjust torsion bars at adjusting ends until recommended heights are obtained.

10.2203 Settle front of vehicle and recheck vertical height readings.

PERFORMANCE STANDARDS:

- On instructor provided vehicle with torsion bars out of adjustment, adjust torsion bars to manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 10.0 STEERING AND SUSPENSION - LEVEL III

TASK 10.22B REPLACE TORSION BARS

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PERFORMANCE OBJECTIVE:

Given vehicle with torsion bars, access to appropriate tools, equipment, and service manual; remove and replace torsion bars according to manufacturer's procedures and specifications.

PERFORMANCE ACTIONS:

10.2201 Raise vehicle from floor following safety procedures.

10.2202 Lift vehicle body to extend lower control arms in full rebound position.

10.2203 Release all load from torsion bar by turning anchor adjustings bolt counterclockwise.

10.2204 Remove torsion bars by sliding bar out through rear of rear anchor.

10.2205 Install new torsion bars following procedures in reverse order.

10.2206 Adjust torsion bars to height specifications.

PERFORMANCE STANDARDS:

- Replace torsion bars on vehicle provided by instructor.

SUGGESTED INSTRUCTION TIME: 6 Hours (each)

UNIT 10.0 STEERING AND SUSPENSION - LEVEL III

TASK 10.23 BALANCE WHEELS AND TIRES

---

## PERFORMANCE OBJECTIVE:

Given a wheel and tire assembly, wheel balancer, and proper tools and wheel weights, balance the assembly.

## PERFORMANCE ACTIONS:

10.2301 Check wheel and tire runout, looking especially for excessive lateral or radial runout.

10.2302 If tire runout is excessive, check wheel runout. If feasible deflate tire, break beads and shift tire on rim until tire point of maximum runout is opposite point of maximum wheel runout. (Runout may be checked using indicator.)

10.2303 STATIC BALANCE wheel by clipping weights to rim opposite heavy side. (If more than 2 ounces of weight is required, split the weight, adding half to the inside of the wheel rim so the dynamic balance will not be disturbed.)

10.2304 DYNAMIC BALANCE wheel, after wheel is static balanced, by adding wheel balance weights in amounts sufficient to bring weight mass and wheel center lines into same plane.

10.2305 (OPTIONAL) OFF CAR BALANCE, provided an off car balancing machine is available, first balance the tire statically, then balance it dynamically.

10.2306 (OPTIONAL) COMPUTER BALANCE THE WHEEL (ORIENTATION thru field visit or audio-visual presentation.)

## PERFORMANCE STANDARDS:

- Balance wheels and tires provided by the instructor using proper tools, equipment, and materials. First static balance, then dynamic balance a wheel.
- Upon completion, there must be "wheel tramp" (tire and wheel hopping up and down) or "wobble" (shimmy).

SUGGESTED INSTRUCTION TIME: 2 Hours (per wheel)

*Depends on type of balancing procedures. Speed or Bubble balancing.

UNIT 10.0 STEERING AND SUSPENSION - LEVEL III

TASK 10.24 REMOVE AND REPLACE STEERING SPINDLE (BALLJOINT TYPE)

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PERFORMANCE OBJECTIVE:

Given a vehicle, service manual, and proper tools; remove and replace the steering spindle. When completed, all attaching bolts and cotter pins will be checked for security.

PERFORMANCE ACTIONS:

10.2401 Raise vehicle from floor.

10.2402 Remove both front wheel assemblies.

10.2403 For disc brakes, remove front wheels and brake calipers. Remove rotor and hub assemblies.

10.2404 Using a dial indicator, determine the need for spindle replacement.

10.2405 Following vehicle manufacturer's procedures, remove and replace spindles.

10.2406 Pack front wheel bearings with proper lubricant.

10.2407 Replace grease seals where necessary.

10.2408 Install wheel assemblies and adjust bearings to proper specifications.

10.2409 Refer to vehicle specifications for wheel alignment where applicable.

10.2410 For disc brakes, install calipers and check brake operation.

10.2411 Road test for performance.

PERFORMANCE STANDARDS:

- Replace defective steering spindles in vehicle provided by instructor.

SUGGESTED INSTRUCTION TIME: 4 Hours (per side)

UNIT 10.0 STEERING AND SUSPENSION - LEVEL III

TASK 10.25 INSPECT AND ALIGN FRONT END

---

PERFORMANCE OBJECTIVE:

Given a vehicle with the front end out of alignment, and access to a service manual, special tools, and equipment; check the wheel alignment angles and align the front wheel following the manufacturer's specifications and procedures.

PERFORMANCE ACTIONS:

10.2051 Look up manufacturer's specifications for vehicle.

10.2502 Place vehicle on wheel alignment rack or front wheels on turning radius gauges.

10.2503 Place front wheels in straight ahead direction and install pedal depressor to lock brakes of all four wheels.

10.2504 Install or attach wheel alignment clamps/gauges to front wheel and measure caster, camber steering axis inclinator, turning radius, and toe-in angles.

10.2505 Perform caster, camber, and toe-in adjustments to manufacturer's specifications.

10.2506 Adjust wheel alignment angles to recommended settings.

10.2507 Road test vehicle.

PERFORMANCE STANDARDS:

- On an instructor provided automobile, align the front wheels to meet the manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 4 Hours (minimum) * (per student)

*Instructional time will vary according to the type of vehicle and knowledge and skill of student.

UNIT 10.0 STEERING AND SUSPENSION - LEVEL III

TASK 10.26 INSPECT AND SERVICE REAR END

---

PERFORMANCE OBJECTIVE:

On a given automobile with known defects, manufacturer's service manual, necessary tools and equipment; inspect and service the rear end suspension.

PERFORMANCE ACTIONS:

10.2601 Inspect the vehicle for normal rear suspension standing (curb) height. (Measured from top of rear axle housing to given point on frame.)

10.2602 Inspect and replace, as necessary, rear suspension control arms or bushings.

10.2603 Check drive angle of differential pinion and adjust as needed.

PERFORMANCE STANDARDS:

- Inspect and service rear end suspension according to manufacturer's procedures making necessary adjustments to bring vehicle to manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 1 Hour Inspection
Additional hours required as necessary for service to be estimated by Rate Manual.

## TASK LISTINGS
## AUTOMOTIVE MECHANICS

| UNIT/TASK | DESCRIPTION |
|---|---|
| Unit 11.0 | BRAKING SYSTEM MAINTENANCE AND REPAIR |
| 11.01 | (Identify Types and Grades of Brake Fluid) Given supply catalog, identify the recommended type and grade of brake fluid to use for a given vehicle or to stock. |
| 11.02 | (Check Brake Master Cylinder Fluid and Fill To Proper Levels) Given an automobile, determine the brake fluid level in the brake system master cylinder and fill it to the manufacturer's specifications using SAW approved brake fluid. |
| 11.03 | (Inspect Brake Lines for Condition and Leaks) Given a vehicle needing a visual brake inspection, service manual, and access to necessary tools and equipment; perform a visual inspection of all system components, within twice the time allowed by the flat rate manual. |
| 11.04 | (Inspect Parking Brake Operation) Given a vehicle with parking brake to inspect for proper operation, service manual as necessary, needed tools and equipment; inspect the parking brake for proper holding action and operation. |
| 11.05 | (Adjust Service Brakes [Non-Self-Adjusting] ) Given a vehicle with non-self-adjusting brakes, service manual, and access to necessary tools and equipment; adjust the brakes so that each wheel is free of drag and the vehicle will not pull to either side when brakes are engaged. Performance should be accomplished within twice the time allowed by the flat rate manual. |
| 11.06A | (Adjust Hand Brake Linkage) Given a vehicle and using the proper tools, equipment, and service manual; adjust the parking brake linkage in accordance with the manufacturer's procedures and specifications. When completed, the hand brake will not drag or stick when placed or released into position. Linkage must be properly routed, secured and positioned, and the vehicle will not roll with parking brake applied. |
| 11.06B | (Adjust External Band) Given a vehicle, access to proper tools, equipment, and service manual; adjust external band following the manufacturer's procedures and specifications. |
| 11.07 | (Inspect Brake Pedal Height and Perform Required Adjustment) Given an automobile, service manual, appropriate tools and equipment; inspect brake pedal height for proper free pedal travel range and adjust the pedal for proper height and pedal travel range. |

11.08 (Replace Hand Brake Linkage) Given an automobile with defective parking brake linkage, and the necessary tools, equipment, and service manual; remove and replace the hand brake linkage in accordance with the manufacturer's recommended procedures and specifications.

11.09 (Bleed Hydraulic Brakes /_Manual_7 ) Given a vehicle with hydraulic brakes and access to the proper tools, equipment, and service manual; manually bleed the hydraulic brake system to expel all air, in accordance with the manufacturer's procedures.

11.10 (Diagnose Brake System Problems) Given an automobile with possible braking system malfunction or problem, service manual, necessary tools, equipment, and materials; inspect the braking system of the vehicle and diagnose the probable problem(s).

11.11 (Service Brake Warning System) Given an automobile with a malfunctioning or defective service brake warning system, service manual, proper tools and equipment, and parts as necessary; inspect the service brake warning system and repair or replace the system component causing the problem. Upon completion, the service brake warning system must be fully operational.

11.12 (Inspect and Replace Brake Metering Valve) Given a vehicle with a disc brake metering valve to service, manufacturer's service manual, necessary tools and equipment; inspect the brake metering valve and replace it if found inoperative.

11.13 (Inspect, Repair, or Replace Self-adjusters) Provided a vehicle with self-adjusting drum brakes, service manual, necessary tools, equipment, and materials, inspect the self-adjusters for proper operation and, if a repairable malfunction exists, make the necessary repairs or replace the self-adjusters if repair is not feasible.

11.14 (Replace Brake Hoses and Lines) Given a vehicle with hydraulic brakes, service manual, necessary tools and equipment, and replacement parts; remove and replace the hydraulic brakes lines, hoses, and fittings, according to manufacturer's recommended procedures. When completed, there must be no leaks in the hoses, lines, and fittings.

11.15A (Inspect and Replace Brake Pads /‾Disc Brakes‾/ ) Given a vehicle with worn disc brake pads, service manual, necessary tools, equipment, and replacement parts; service or replace the pads according to manufacturer's specifications and procedures. Service should be accomplished within twice the time allowed by the flat rate manual.

11.15B (Repair Disc Brake Calipers) Given a vehicle with a malfunction in the disc brake caliper assembly, service manual, necessary tools and equipment, and parts; remove and replace the caliper and rotor according to manufacturer's procedures so there will be no fluid leakage and no air expelled while bleeding with the system under pressure.

11.16 (Inspect and Replace Brake Shoes) Given a vehicle with worn brake shoes, service manual, proper tools and equipment and replacement parts as needed; replace brake shoes according to manufacturer's procedures and specifications.

11.17 (Inspect and Turn Rotor on Disc Brakes) Given a vehicle with disc brakes, service manual, tools and equipment, micrometer and proper gauges; inspect and refinish the rotor following the manufacturer's specifications.

11.18 (Inspect and Refinish Brake Drums) Given a set of brake drums, and the proper micrometers and equipment and service data; inspect and refinish the brake drums following manufacturer's specifications.

11.19 (Radius Grind Brake Shoes) Given a vehicle, service manual, machine operation manual, brake shoes, brake drum, drum micrometer, and brake shoe grinder; radius (arc) grind the brake shoes to match drum diameters.

11.20 (Inspect, Repair, or Replace Wheel Cylinder) Given an automobile with a defective wheel cylinder, proper tools, equipment, and service manual; inspect the wheel cylinder, remove, rebuild, or replace the cylinder according to manufacturer's recommended procedures and specifications.

11.21A (Remove or Replace Master Cylinder) Given an automobile with a defective brake cylinder, service manual, necessary tools, and equipment, and replacement parts; remove and replace master cylinder according to manufacturer's procedures.

11.21B (Repair Master Cylinder) Given a master cylinder with repairable malfunction, and necessary service information, tools, equipment, and parts; repair master cylinder following manufacturer's procedures and specifications.

11.22 (Repair or Replace Hydraulic Power Brake Components)

A-D Multiple Tasks

11.22A REPLACE HYDRAULIC CONTROL VALVES

Given a vehicle with defective hydraulic control valves in braking system, service manual, appropriate tools and equipment, remove and replace the valves in accordance with the manufacturer's procedures and specifications.

11.22B REPLACE HYDRAULIC BRAKE POWER UNITS

Given a vehicle with a defective hydraulic brake power unit and conditions similar to above, A; remove and replace the unit according to manufacturer's procedures and specifications.

11.22C REPLACE HYDRAULIC POWER CYLINDER

Given a vehicle with defective hydraulic power cylinder and other conditions outlined in A, above; remove and replace the hydraulic power cylinder according to manufacturer's procedures and specifications. When completed, there will be no leaks around the cylinder.

11.22D REBUILD HYDRAULIC BRAKE POWER UNIT

Given a repairable hydraulic power brake unit, and access to necessary tools, equipment, and service data; rebuild the hydraulic brake power unit, following manufacturer's procedures and specifications. When completed, the brake system will have no leaks or air in the lines.

11.23 (Perform Operational Brake Inspection) Provided a vehicle, a service manual, and the necessary tools and equipment; perform an operational brake inspection (test) according to the manufacturer's procedures and tolerances. The inspection should be accomplished within twice the time allowed by the flat rate manual.

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| UNIT | 11.0 | BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL I |
| TASK | 11.01 | IDENTIFY TYPES AND GRADES OF BRAKE FLUID |

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PERFORMANCE OBJECTIVE:

Given supply catalog, identify the recommended type and grade of brake fluid to use for a given vehicle or to stock.

PERFORMANCE ACTIONS:

11.0101 Identify top quality, super heavy-duty fluid as preferred type.

11.0102 Use only specified fluids for vehicle and conditions.

11.0103 Do not reuse brake fluid.

11.0104 Identify brake fluids that should not be mixed.

PERFORMANCE STANDARDS:

- Identify the recommended types and grades of brake fluid.

SUGGESTED INSTRUCTION TIME: 1/2 Hour

UNIT 11.0 BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL I

TASK 11.02 CHECK BRAKE MASTER CYLINDER FLUID FILL TO PROPER LEVELS

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PERFORMANCE OBJECTIVE:

Given an automobile, determine the brake fluid level in the brake system master cylinder and fill it to the manufacturer's specifications using SAW approved brake fluid.

PERFORMANCE ACTIONS:

11.0201 Prepare to check brake fluid level.

11.0202 Clean area around master cylinder cap(s) with shop cloth, as necessary.
(NOTE: Dirt should not fall in the brake fluid since it may damage the brake system.)

11.0203 Remove master cylinder cap.

11.0204 Check level of brake fluid.
(NOTE: Fluid should be about 1/4 inch from top.)

11.0205 Put brake fluid pump hose in filler hole, if fluid needed.

11.0206 Pump brake fluid into master cylinder until level is brought up to 1/4 inch from top.

11.0207 Remove pump hose from master cylinder.
(NOTE: Be careful not to drip fluid on car paint.)

11.0208 Wipe filler cap clean with shop cloth; check vent hole to be sure air can pass through it.

11.0209 Replace filler cap on master cylinder being sure no dirt falls into cylinder and secure cap is secured.

PERFORMANCE STANDARDS:

- Determine brake fluid level for a given automobile by checking the brake system master cylinder and, if needed, fill it to manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: ½ Hour

RELATED TECHNICAL INFORMATION:

- Manufacturer's specifications: Fill level, fluid, etc.

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| UNIT | 11.0 | BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL I |
| TASK | 11.03 | INSPECT BRAKE LINES FOR CONDITION AND LEAKS |

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PERFOMRANCE OBJECTIVE:

Given a vehicle needing a visual brake inspection, service manual, and access to necessary tools and equipment; perform a visual inspection of all system components, within twice the time allowed by the flat rate manual.

PERFORMANCE ACTIONS:

11.0301 Visually inspect given vehicle for:
- Master cylinder reservoir fluid level.
- Leaks.
- Brake hose condition.
- Brake lining condition and thickness.
- Brake drum diameter, and condition.
- Brake rotor thickness, runout, and parallelism.
- Brake pad thickness.

PERFORMANCE STANDARDS:

- Perform a visual inspection of all system components within twice the time allowed by the flat rate manual.

SUGGESTED INSTRUCTION TIME: 3 Hours

RELATED TECHNICAL INFORMATION:

- Safety procedures while removing wheels, using lift, etc.
- Specifications for vehicle being serviced.
- Rotor runout and parallelism.
- Proper procedures for wheel removal.

UNIT 11.0 BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL II

TASK 11.04 INSPECT PARKING BRAKE OPERATION

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PERFORMANCE OBJECTIVE:

Given a vehicle with parking brake to inspect for proper operation, service manual as necessary, needed tools and equipment; inspect the parking brake for proper holding action and operation.

PERFORMANCE ACTIONS:

11.0401 Place parking brake on. Place vehicle in drive. Take necessary safety precautions. Push accelerator slightly to test holding power of parking brakes. (CAUTION: If brakes do not hold, take quick responsive action.)

11.0402 Check parking brake cable for proper operation and condition. Look for fraying cable, binding, etc.

11.0403 If appropriate, inspect for proper cable clearances.

PERFORMANCE STANDARDS:

- Engage parking brake and check holding power of parking brake with vehicle started, placed in drive gear, and slightly accelerated.
- Vehicle should not move and should stall if acceleration continued.
  (CAUTION: Take necessary safety precautions.)

SUGGESTED INSTRUCTION TIME: 1 Hour

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| UNIT | 11.0 | BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL II |
| TASK | 11.05 | ADJUST SERVICE BRAKES (NON-SELF-ADJUSTING) |

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PERFORMANCE OBJECTIVE:

Given a vehicle with non-self-adjusting brakes, service manual, and access to necessary tools and equipment; adjust the brakes so that each wheel is free of drag and the vehicle will not pull to either side when brakes are engaged. Performance should be accomplished within twice the time allowed by the flat rate manual.

PERFORMANCE ACTIONS:

11.0501 Raise vehicle properly so that wheels are off floor. Support vehicle following accepted safety practices.

11.0502 Remove brake backing plate dust seals-Bendix brakes.

11.0503 With proper brake adjusting spoon, turn star-wheel adjuster following manufacturer's procedures.

11.0504 Following the brake adjustment to each wheel, check brake pedal operation and reinstall dust seals.

PERFORMANCE STANDARDS:

- Perform major adjustments of drum-type non-self-adjusting brakes.
- Upon completion, each wheel must be free of drag and the vehicle must not pull to either side when the brakes are engaged.
- Performance should be accomplished within twice the time allowed by the flat rate manual.

SUGGESTED INSTRUCTION TIME: 2 Hours

RELATED TECHNICAL INFORMATION:

- Safety precautions necessary when working with a brake system.
- Correct direction to move adjuster (star wheel).
- Proper adjustment of drum brake system.
- Importance of type, size, and air pressure in tires.

UNIT 11.0 BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL II

TASK 11.06 A ADJUST HAND BRAKE LINKAGE

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## PERFORMANCE OBJECTIVE:

Given a vehicle and using the proper hand tools, equipment, and service manual; adjust the parking brake linkage in accordance with the manufacturer's procedures and specifications. When completed, the hand brake will not drag or stick when placed or released into position. Linkage must be properly routed, secured and positioned, and the vehicle will not roll with parking brake applied.

## PERFORMANCE ACTIONS:

11.0601 Locate vehicle manufacturer's service information for hand brake adjusting procedures and specifications.

11.0602 Raise vehicle from floor and support the vehicle following accepted safety practices.

11.0603 Disconnect parking brake linkage.

11.0604 Connect and adjust linkage according to manufacturer's procedures.

11.0605 Check rear wheels for drag or free rotation, with hand brake "off."

## PERFORMANCE STANDARDS:

- Adjust the parking brake linkage on the vehicle provided by the instructor so that it meets manufacturer's specifications with linkage properly routed, secured and positioned, and so the vehicle will not roll with parking brake applied. Hand brake will not drag or stick when placed or released into position.

SUGGESTED INSTRUCTION TIME: 1 Hour

## RELATED TECHNICAL INFORMATION:

- Safety precautions.

UNIT 11.0 BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL II

TASK 11.06 B ADJUST EXTERNAL BAND

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PERFORMANCE OBJECTIVE:

Given a vehicle, access to proper tools, equipment, and service manual; adjust external band following the manufacturer's procedures and specifications.

PERFORMANCE ACTIONS:

11.0601 Raise vehicle from floor and support vehicle following accepted safety practices.

11.0602 Adjust external band by tightening the screw, the centering bolt and the adjusting nut in that order, until a minimum clearance is obtained around the drum.

11.0603 Check drive shaft for free rotation with hand brake "off."

PERFORMANCE STANDARDS:

- Adjust the hand brake external band on the vehicle provided by the instructor.
- The vehicle will not roll with parking brake engaged and proper clearance will be set between band and lining with the brake disengaged.

SUGGESTED INSTRUCTION TIME: 2 Hours

RELATED TECHNICAL INFORMATION:

- Safety precautions.
- Measurement and adjustment of external bands.

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| UNIT | 11.0 | BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL II |
| TASK | 11.07 | INSPECT BRAKE PEDAL HEIGHT AND PERFORM REQUIRED ADJUSTMENTS |

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## PERFORMANCE OBJECTIVE:

Given an automobile, service manual, appropriate tools and equipment; inspect brake pedal height for proper free pedal travel range and adjust the pedal for proper height and pedal travel range.

## PERFORMANCE ACTIONS:

11.0701 Review specification for vehicle's brake pedal height and free pedal travel range.

11.0702 Measure pedal height from toe-board to bottom of pedal.

11.0703 Check against specifications and adjust if needed.

11.0704 Determine if the brake pedal free travel is set automatically or manually.

11.0705 If the brake pedal used a separate pedal stop, check the distance from the push rod to face of booster. (Use a special gauge.) Adjust (where possible) for proper free travel (about 1/4-1/2 inch for manual brakes, about 1/8-3/8 inch for power brakes).

## PERFORMANCE STANDARDS:

- Inspect and adjust, where possible, the brake pedal height and brake pedal travel range to meet manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 1 Hour

UNIT 11.0 BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL II

TASK 11.08 REPLACE HAND BRAKE LINKAGE

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PERFORMANCE OBJECTIVE:

Given an automobile with defective parking brake linkage, and the necessary tools, equipment, and service manual; remove and replace the hand brake linkage in accordance with the manufacturer's recommended procedures and specifications.

PERFORMANCE ACTIONS:

11.0801 Raise vehicle from floor and support vehicle following accepted safety practices. Place parking pedal in release position.

11.0802 For rear cables, remove rear wheels, drums, and brake shoes. Disconnect cable ends at equalizer.

11.0803 For front cables, separate cable stud from equalizer. Remove end of cable from pedal clevis. Rmove mounting bolts/clips and withdraw cable.

11.0804 Install brake shoes, pedal clevis and/or rear brake shoes.

11.0805 Install brake shoes, drums, and wheel. Adjust hand brake cables.

11.0806 Check adjustment. Rear wheels must turn freely without drag with parking brake "off."

PERFORMANCE STANDARDS:

- Replace hand brake linkage in accordance with manufacturer's recommended procedures and specifications.
- The rear wheels must turn freely without draw with the parking brake "off."

SUGGESTED INSTRUCTION TIME: 10 Hours

UNIT 11.0 BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL II

TASK 11.09 BLEED HYDRAULIC BRAKES (MANUAL)

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PERFORMANCE OBJECTIVE:

Given a vehicle with hydraulic brakes and access to the proper tools, equipment, and service manual; manually bleed the hydraulic brake system to expel all air, in accordance with the manufacturer's procedures.

PERFORMANCE ACTIONS:

11.0901 Raise vehicle from floor. Follow accepted safety practices.

11.0902 Clean all wheel cylinder bleeder screws. Remove cap or plug from bleeder screw, if appropriate.
(NOTE: Two persons are required to properly do this task.)

11.0903 Install bleeder hose over bleeder valve at wheel having longest brake line. Insert free end of hose into clean container partially full of clean brake fluid. (Keep end of hose in container below fluid level during bleeding.) (Glass jar will permit mechanic to see air bubbles leaving system.)
(NOTE: Bleeder valve remains closed until pressure is built up.

11.0904 Remove master cylinder top and fill cylinder. Keep cylinder full during bleeding.

11.0905 Pump brake pedal slowly with bleeder valve closed, until pressure builds up in system. Hold pedal down maintaining pressure on system.

11.0906 With pressure on system, open bleeder screw 3/4 turn. Pedal should be pressed down. Close bleeder before pedal reaches floor to prevent loss of pressure in system and prevent air or dirty fluid from being drawn back into system.

11.0907 Repeat steps 4-6 until system is free of air.

11.0908 Tighten bleeder screw. Move to wheel on opposite side of car. Bleed remaining wheel cylinders in recommended order.

PERFORMANCE ACTIONS (Con't.):

(NOTE: On older vehicles with two drum brake wheel cylinders, bleed upper wheel cylinder first, then the lower wheel cylinder.)

11.0909 Check that all bleeder screws are shut off firmly. Refill reservoir to correct level, install filler cap, whip clean.

11.0910 Check brake pedal action. Adjust as necessary.

11.0911 Discard brake fluid in jar: It must not be reused in system.

11.0912 Road test vehicle.

PERFORMANCE STANDARDS:

- Manually bleed hydraulic brake system on vehicle provided by instructor.

SUGGESTED INSTRUCTION TIME: 3 Hours

RELATED TECHNICAL INFORMATION:

- PRESSURE BLEEDING (Recommended for disc brakes)
  - Where a pressure bleeding tank is available, only one man is needed to bleed the brake system.
  - Fill tank to specified level and charge with air. Bleed as required and attach to filled master cylinder reservoir. Turn on tank hose valve and admit fluid to master cylinder. Follow bleeding steps above. Shut off pressure tank and remove. Siphon off enough fluid to lower master cylinder fluid level to 3/8 inch from top.
- BLEEDING DISC BRAKE SYSTEMS
  - It may be necessary to block open the metering valve on front disc brakes when bleeding. Some systems require removal of the pressure differential warning light switch terminal and plunger to prevent switch damage during bleeding.
- (NOTE: Front and rear hydraulic system (dual master cylinder) are individual systems and must be bled separately.)

UNIT 11.0 BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL III

TASK 11.10 DIAGNOSE BRAKE SYSTEM PROBLEMS

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PERFORMANCE OBJECTIVE:

Given an automobile with possible braking system malfunction or problem, service manual, necessary tools, equipment, and materials; inspect the braking system of the vehicle and diagnose the probable problem(s).

(NOTE: See Stockel Auto Service and Repair, pages 683-685, for a good outline of brake system problem diagnosis causes and corrections.)

PERFORMANCE ACTIONS:

11.1001 Possible problems:
- No pedal, no brakes.
- Spongy pedal.
- Hard pedal (excessive foot pressure required).
- Brakes grab (one or more wheels).
- Brakes fade.
- Brakes pull car to one side.
- Brakes drag.
- "Nervous" pedal (pedals moves rapidly in and out when applying brakes).
- Brakes chatter.
- Brakes squal.
- Shoes click.
- Automatic shoe adjusters will not function.

PERFORMANCE STANDARDS:

- Diagnose brake system problems on a given vehicle with 100 percent accuracy (if previously identified by instructor).

SUGGESTED INSTRUCTION TIME: 4 Hours

RELATED TECHNICAL INFORMATION:

- RECOMMENDATION: "Never do half-way brake jobs. If the customer insists on shortcuts to save a few pennies, refuse the job. Do it right or not at all. Good brakes are important not only to the owner but to everyone on the highway."
(Stockel, Auto Service and Repair, p. 673)

UNIT 11.0 BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL III

TASK 11.11 SERVICE BRAKE WARNING SYSTEM

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PERFORMANCE OBJECTIVE:

Given an automobile with a malfunctioning or defective service brake warning system, service manual, proper tools and equipment, and parts as necessary; inspect the service brake warning system and repair or replace the system component causing the problem. Upon completion, the service brake warning system must be fully operational.

PERFORMANCE ACTIONS:

11.1101 Review service manual and determine if the stoplight switch is operated by pressure in the brake system (hydraulic) or by the brake pedal (mechanical).

11.1102 Diagnose the actual malfunction in the system.

11.1103 Adjust mechanical switch as specified so that only a small amount of brake pedal movement is necessary to operate the switch.
(NOTE: Stoplight switch must not prevent the brake pedal from returning to full release position.)

11.1104 If the problem is other than the stoplight switch, perform the necessary electrical or mechanical inspections to identify the cause. Repair as outlined in the service manual.

PERFORMANCE STANDARDS:

- Inspect, repair, or replace the service brake warning system so that the system is fully operational meeting the manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 2 Hours

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| UNIT | 11.0 | BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL III |
| TASK | 11.12 | INSPECT AND REPLACE BRAKE METERING VALVE |

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PERFORMANCE OBJECTIVE:

Given a vehicle with a disc brake metering valve to service, manufacturer's service manual, necessary tools and equipment; inspect the brake metering valve and replace it if found inoperative.

(NOTE: When bleeding disc brakes, it may be necessary to hold the valve open to allow low pressure brake fluid to pass through the valve. A special metering valve tool may be required for this purpose. See manufacturer's specifications and procedures.)

PERFORMANCE ACTIONS:

11.1201 Locate the metering valve between the master cylinder and the front disc brake caliper assembly.

11.1202 Follow manufacturer's service manual procedures for determining proper operation of metering valve.

11.1203 Replace if unit is inoperative.

11.1204 Bleed brakes.

PERFORMANCE STANDARDS:

- Inspect and replace brake metering valve on disc brake equipped vehicle provided by the instructor.
- Valve must not leak fluid and air will be removed from system by bleeding front and rear systems at nearest bleeder screw.

(NOTE: Unit may be a "Combination Valve" functioning as a brake warning, proportioning valve, and metering valve assembly. Unit should be replace if found to function improperly.)

SUGGESTED INSTRUCTION TIME: 3 Hours

UNIT 11.0 BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL III

TASK 11.13 INSPECT, REPAIR, OR REPLACE SELF-ADJUSTERS

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PERFORMANCE OBJECTIVE:

Provided a vehicle with self-adjusting drum brakes, service manual, necessary tools, equipment, and materials, inspect the self-adjusters for proper operation and, if a repairable malfunction exists, make the necessary repairs or replace the self-adjusters if repair is not feasible.

PERFORMANCE ACTIONS:

11.1301 Raise vehicle from floor. Follow accepted safety procedures for supporting vehicle.

11.1302 Remove wheels, drums, brake shoes and self-adjusters.

11.1303 Inspect, clean, and lubricate the star wheel adjusters, self-adjusting components and backing plate bosses.

11.1304 Reinstall self-adjuster, brake shoes, drums and wheels replacing any component found defective.

11.1305 Readjust brakes.

11.1306 Check brake pedal operation.

11.1307 Road test vehicle and make final adjustment of brakes.

PERFORMANCE STANDARDS:

- Locate and repair a malfunction in self-adjusters or remove and replace the self-adjusters on a given vehicle.

SUGGESTED INSTRUCTION TIME: 3 Hours

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| UNIT | 11.0 | BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL III |
| TASK | 11.14 | REPLACE BRAKE HOSES AND LINES |

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PERFORMANCE OBJECTIVE:

Given a vehicle with hydraulic brakes, service manual, necessary tools and equipment, and replacement parts; remove and replace the hydraulic brake lines, hoses, and fittings, according to manufacturer's recommended procedures. When completed, there must be no leaks in the hoses, lines, and fittings.

PERFORMANCE ACTIONS:

11.1401 Raise vehicle from floor and support vehicle following accepted safety practices.

11.1402 Disconnect hydraulic line fittings and remove brake by hydraulic line(s).

11.1403 Install new brake line(s).

11.1404 Refill master cylinder with proper brake fluid and bleed hydraulic brake system to expel all air.

11.1405 Check brake pedal operation. Road test vehicle.

PERFORMANCE STANDARDS:

- Replace hydraulic brake lines, hoses, and fittings on vehicle provided by instructor.

SUGGESTED INSTRUCTION TIME: 3 Hours

UNIT 11.0 BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL III

TASK 11.15 A INSPECT AND REPLACE BRAKE PADS (DISC BRAKES)

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## PERFORMANCE OBJECTIVE:

Given a vehicle with worn disc brake pads, service manual, necessary tools, equipment, and replacement parts; service or replace the pads according to manufacturer's specifications and procedures. Service should be accomplished within twice the time allowed by the flat rate manual.

## PERFORMANCE ACTIONS:

11.1501 Locate manufacturer's service information for disc brake pad thickness specifications and replacement procedures.

11.1502 Raise vehicle from floor and support it following accepted safety practices.

11.1503 Remove front wheels from vehicle.

11.1504 Check shoe pad thickness.

11.1505 Remove disc brake caliper; replace shoe pads and reinstall the brake assembly following proper procedures.

11.1506 Check brake pedal operation.

11.1507 Reinstall front wheels and torque to specifications.

## PERFORMANCE STANDARDS:

- Replace disc brake pads on vehicle provided by instructor.
- Worn pads will be replaced with proper type pads, caliper support will be properly serviced and anti-rattle springs will be properly positioned.

SUGGESTED INSTRUCTION TIME: 3 Hours

## RELATED TECHNICAL INFORMATION:

- Special tools (brake service).
- Inspecting for rotor wear or warpage.
- Inspection of calipers for corrosion and leakage.

UNIT 11.0 BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL III

TASK 11.15 B REPAIR DISC BRAKE CALIPERS

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PERFORMANCE OBJECTIVE:

Given a vehicle with a malfunction in the disc brake caliper assembly, service manual, necessary tools and equipment, and parts; remove and replace the caliper and rotor according to manufacturer's procedures so there will be no fluid leakage and no air expelled while bleeding with the system under pressure.

PERFORMANCE ACTIONS:

11.1501 With vehicle raised, wheels removed, safety practices observed.

11.1502 Loosen caliper hydraulic brake hose.

11.1503 Remove caliper. Drain brake fluid into pan. (Avoid scratching piston or cylinder wall.)

11.1504 Disassemble caliper - dust boot(s), piston(s), square-cut seals. (Protect pistons and self when removing pistons.

11.1505 Wash caliper with alcohol. Polish bore with crocus cloth.

11.1506 Check piston fit.

11.1507 Install seal(s), piston(s), and boot(s). Coat with lubricant or brake fluid.

11.1508 Reinstall caliper to proper torque specifications.

11.1509 Bleed caliper and check master cylinder fluid levels.

PERFORMANCE STANDARDS:

- Repair malfunctioning disc brake caliper on vehicle provided.

SUGGESTED INSTRUCTION TIME: 5 Hours

RELATED TECHNICAL INFORMATION:

- Proper lubrication of rotor bearings, seal inspection, and bearing adjustment while caliper is off for pad replacement.

RELATED TECHNICAL INFORMATION (Con't.):

- Brake pad removal and safety placement of caliper.
- Use of micrometer to inspect and measure wear of rotor.
- Rotor lubrication and bearing adjustment.
- Brake drum servicing.

# SAFETY PRECAUTIONS
# IN BRAKE SERVICE

"WARNING: Brake friction materials contain asbestos - A known carcinogen (substance that can cause cancer)."

"Grinding linings, cleaning brake assemblies, etc., can produce small airborne particles of asbestos. These are easily inhaled by the mechanic. Breathing these particles may cause cancer."

Observe these rules when performing brake service!

"1. Never use compressed air to blow brake assemblies clean. Use a vacuum source or flush with eater.
2. Equip brake shoe grinders with an efficient dust removal system. Turn on system when grinder is in operation.
3. When some exposure might be unavoidable, wear an approved filter mask."

Stockel, Auto Service and Repair, p. 648

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| UNIT | 11.0 | BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL III |
| TASK | 11.16 | INSPECT AND REPLACE BRAKE SHOES |

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PERFORMANCE OBJECTIVE:

Given a vehicle with worn brake shoes, service manual, proper tools and equipment and replacement parts as needed; replace brake shoes according to manufacturer's procedures and specifications.

PERFORMANCE ACTIONS:

11.1601 Locate car manufacturer's service information for proper procedures.

11.1602 Raise vehicle. Support it following accepted safety standards.

11.1603 Remove wheels and drums.

11.1604 Remove old brake shoes.

11.1605 Clean brake backing plates and lubricate backing plate hoses.

11.1606 If applicable, arc grind new brake shoes to fit drum diameters.

11.1607 Install brake shoes following proper procedures.

11.1608 Reinstall drums and wheels; adjust brake shoes.

11.1609 Check brake pedal operation.

11.1610 Road test vehicle and make final adjustments of brakes.

PERFORMANCE STANDARDS:

- Replace brake shoes on vehicle provided by the instructor.

SUGGESTED INSTRUCTION TIME: 5 Hours

UNIT 11.0 BRAKING SYSTEM MAINTENANCE AND REPAIR -- LEVEL III

TASK 11.17 INSPECT AND TURN ROTOR ON DISC BRAKES

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PERFORMANCE OBJECTIVE:

Given a vehicle with disc brakes, service manual, tools and equipment, micrometer and proper gauges; inspect and refinish the rotor following the manufacturer's specifications.

PERFORMANCE ACTIONS:

11.1701 Locate manufacturer's service information for disc brake rotor specifications and removal and installation procedures.

11.1702 Locate disc brake lathe operation instruction manual.

11.1703 Raise vehicle and support it according to accepted safety practices.

11.1704 Check front wheel bearing adjustment.

11.1705 Remove front wheel.

11.1706 Check disc brake rotor lateral runout. Check rotor thickness and parallelism, if necessary.

11.1707 Remove caliper rotor; mount rotor to lathe an refinish to manufacturer's specifications.

11.1708 Reinstall rotor to vehicle.

11.1709 Install caliper and check brake pedal operation.

11.1710 Road test vehicle.

PERFORMANCE STANDARDS:

- On a given automobile with disc brake rotor needing refinishing, turn the rotor to meet manufacturer's specifications.
- Caliper support will be properly serviced, pads properly located, and anti-rattle springs will be properly positioned.

SUGGESTED INSTRUCTION TIME: 6 Hours

UNIT 11.0 BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL III

TASK 11.18 INSPECT AND REFINISH BRAKE DRUMS

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PERFORMANCE OBJECTIVE:

Given a set of brake drums, and the proper micrometers and equipment and service data; inspect and refinish the brake drums following manufacturer's specifications.

PERFORMNACE ACTIONS:

11.1801 Locate manufacturer's service data for drum diameter specifications and the drum lathe manufacturer's operating instruction manual.

11.1802 Inspect brake drums and measure drum diameters.

11.1803 Mount drum to drum lathe.

11.1804 Operate lathe according to manufacturer's procedures adhering to accepted safety practices.

11.1805 Refinish drum to manufacturer's specifications.

11.1806 Repeat above steps to refinish remaining drums.

PERFORMANCE STANDARDS:

- On instructor provided brake drums needing refinishing, refinish drums to meet manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 4 Hours

UNIT 11.0 BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL III

TASK 11.19 RADIUS GRIND BRAKE SHOES

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PERFORMANCE OBJECTIVE:

Given a vehicle, service manual, machine operation manual, brake shoes, brake drum, drum micrometer, and brake shoe grinder; radius (arc) grind the brake shoes to match drum diameters.

PERFORMANCE ACTIONS:

11.1901 Raise vehicle so wheels are off floor. Support vehicle following accepted safety practices.

11.1902 Remove all four or rear wheel assemblies only.

11.1903 Remove brake shoes.

11.1904 Check grinder for calibration and proper abrasive.

11.1905 Measure brake drum diameter and adjust brake shoe grinder according to equipment and manufacturer's procedures.

11.1906 Mount brake shoe on grinder machine using proper attachments.

11.1907 Arc grind shoes to required arc.

11.1908 Check shoe-to-brake drum fit for proper toe and heel clearances.

11.1909 Reassemble brakes and test for proper functioning.

PERFORMANCE STANDARDS:

- On instructor provided vehicle requiring brake shoe-to-drum fitting, arc grind the brake shoes to meet manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 6 Hours

UNIT 11.0 BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL III

TASK 11.20 INSPECT, REPAIR, OR REPLACE WHEEL CYLINDER

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## PERFORMANCE OBJECTIVE:

Given an automobile with a defective wheel cylinder, proper tools, equipment, and service manual; inspect the wheel cylinder, remove, rebuild, or replace the cylinder according to manufacturer's recommended procedures and specifications.

## PERFORMANCE ACTIONS:

11.2001 Raise vehicle from floor. Support it following accepted safety practices.

11.2002 Remove wheel assembly.

11.2003 REPAIR WHEEL CYLINDER:

a. Drain wheel cylinder of all brake fluid in waste can.
b. Disassemble wheel cylinder. Remove dust boots, pistons, hydraulic cups and springs. Remove bleeder screw.
c. Clean and polish cylinder with crocus cloth. Hone cylinder where allowed.
d. Measure cylinder diameter or piston fit in accordance with car manufacturer's recommended specifications.
e. Reassemble wheel cylinder installing new parts. Clean bleeder screw and reinstall.

## PERFORMANCE STANDARDS:

- Rebuild wheel cylinder provided by instructor. Cylinder must be rebuilt and installed according to manufacturer's procedures.
- All attaching hardware must be torqued to specifications, pedal must be firm and line connections must not leak.

11.2004 REPLACE WHEEL CYLINDER:

a. Remove brake shoes and disconnect hydraulic line to wheel cylinder.
b. Remove wheel cylinder mounting bolts and wheel cylinder from backing plate.
c. Install new wheel cylinder and reassemble brake shoes and wheel assembly.
d. Check brake adjustment and master cylinder fluid level. Bleed wheel cylinder.

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PERFORMANCE ACTIONS (Con't.):

e. Check brake pedal operator and road test vehicle.

PERFORMANCE STANDARD:

- Replace defective wheel cylinder on automobile provided.
- Cylinder must be installed properly, according to manufacturer's procedures. Attaching hardware must be torqued to specifications, pedal must be firm and line connections must not leak.

SUGGESTED INSTRUCTION TIME: 10 Hours

RELATED TECHNICAL INFORMATION:

- Safety precautions when working in hydraulic brake system.
- Method used to determine master cylinder condition.
- Use of special tools.
- Procedures for cleaning all fluid parts and valves.

UNIT 11.0 BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL III

TASK 11.21 A REMOVE OR REPLACE MASTER CYLINDER

---

PERFORMANCE OBJECTIVE:

Given an automobile with a defective brake cylinder, service manual, necessary tools, and equipment, and replacement parts; remove and replace master cylinder according to manufacturer's procedures.

PERFORMANCE ACTIONS:

11.2101 Raise hood. Install protective fender covers.

11.2102 Disconnect master cylinder, push rod from brake pedal and hydraulic brake line(s). Remove mounting bolts and master cylinder from firewall.

11.2103 If necessary, bench bleed new master cylinder. Fill to recommended fluid levels.

11.2104 Install master cylinder in reverse order. Check and adjust brake pedal free play following manufacturer's specifications.

11.2105 Check brake pedal operation. Bleed master cylinder line(s) or wheel cylinders, if necessary.

PERFORMANCE STANDARDS:

- Remove and replace defective master cylinder on vehicle provided. All attaching hardware must be torqued to specifications.
- Pedal must be firm and line connections must not leak.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 11.0 BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL III

TASK 11.21 B REPAIR MASTER CYLINDER

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PERFORMANCE OBJECTIVE:

Given a master cylinder with repairable malfunction, and necessary service information, tools, equipment, and parts; repair master cylinder following manufacturer's procedures and specifications.

PERFORMANCE ACTIONS:

11.2101 Assemble manufacturer's service information for repair procedures and specifications.

11.2102 Drain master cylinder of brake fluid and disassemble master assembly.

11.2103 Clean and hone cylinder, checking proper piston fit.

11.2104 Install new parts and reassemble master cylinder.

11.2105 Fill with proper brake fluid and bench bleed, if required.

PERFORMANCE STANDARDS:

- On instructor provided malfunctioning master cylinder, locate the problem and repair the master cylinder.

SUGGESTED INSTRUCTION TIME: 2 Hours

TASK 11.22 (MULTIPLE TASKS) REPAIR OR REPLACE HYDRAULIC POWER BRAKE COMPONENTS

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A-D MULTIPLE TASKS

A. REPLACE HYDRAULIC CONTROL VALVES

Given a vehicle with defective hydraulic control valves in braking system, service manual, appropriate tools and equipment; remove and replace the valves in accordance with the manufacturer's procedures and specifications.

1. As necessary, raise vehicle from floor. Support it following accepted safety practices.
2. Disconnect hydraulic line(s) from defective hydraulic control valve and any electrical connections.
3. Remove mounting bolt(s) and valve from vehicle.
4. Install new valve, in reverse order.
5. Bleed hydraulic line(s) at fittings. Check brake pedal operation.
6. Road test vehicle for braking applications.

B. REPLACE HYDRAULIC BRAKE POWER UNITS

Given a vehicle with a defective hydraulic brake power unit and conditions similar to above A, remove and replace the unit according to manufacturer's procedures and specifications.

1. Raise hood. Install fender covers.
2. Disconnent vacuum lines and remove vacuum check valve.
3. Remove master cylinder and position away from power cylinder.
4. Remove clevis pin retainer at brake pedal.
5. Remove power unit-to-dash attaching nuts. Remove power unit.
6. Install new power unit in reverse order.
7. Check brake pedal free play and adjust, if necessary.
8. Check brake pedal operation. Road test vehicle.

C. REPLACE HYDRAULIC POWER CYLINDER

Given a vehicle with defective hydraulic power cylinder and other conditions outlined in A, above, remove and replace the hydraulic power cylinder according to manufacturer's procedures and specifications. When completed, there will be no leaks around the cylinder.

D. REBUILD HYDRAULIC BRAKE POWER UNIT (Typically for older automobiles)

Given a repairable hydraulic power brake unit, and access to necessary tools, equipment, and service data; rebuild the hydraulic brake power unit, following manufacturer's procedures and specifications. When completed, the brake system will have no leaks or air in the lines.

TASK 11.22 (MULTIPLE TASKS) REPAIR OR REPLACE HYDRAULIC POWER BRAKE COMPONENTS

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A-D MULTIPLE TASKS (Con't.):

1. Locate service data for rebuilding.
2. Scribe line across front and rear housing.
3. Remove front housing seal.
4. Rotate rear housing counterclockwise to unlock housings.
5. Remove rear housing and power brake unit.
6. Disassemble power brake unit.
7. Install replacement parts in reverse order and reassemble unit.
8. Pre-test hydraulic brake power unit on test bench, if available.

SUGGESTED INSTRUCTION TIME: 4 Hours

| | | |
|---|---|---|
| UNIT | 11.0 | BRAKING SYSTEM MAINTENANCE AND REPAIR - LEVEL III |
| TASK | 11.23 | PERFORM OPERATIONAL BRAKE INSPECTION |

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## PERFORMANCE OBJECTIVE:

Provided a vehicle, a service manual, and the necessary tools and equipment; perform an operational brake inspection (test) according to the manufacturer's procedures and tolerances. The inspection should be accomplished within twice the time allowed by the flat rate manual.

## PERFORMANCE ACTIONS:

11.2301 Check brake pedal operation. For power brakes, step on brake pedal and start engine.

11.2302 Drive vehicle forward and apply brakes. (Erratic brake action, squal, and pull to one side.)

11.2303 Raise hood. Install fender cover and check master cylinder fluid level and check for signs of leakage.

11.2304 Raise vehicle properly so that wheels are off the floor. Support vehicle following accepted safety practices.

11.2305 Remove all four wheels and wheel assemblies and check all brake components.

## PERFORMANCE STANDARDS:

- Perform an operational brake inspection on a vehicle provided by the instructor. Note any malfunctions in:
  - Brake pedal and master cylinder
  - Stoplight switch - operation
  - Wheel cylinders and brake shoe assemblies - wear, leakage
  - Brake drums - damage, roundness
  - Disc brakes - wear, damage, pistons for leakage
  - Seals - leakage
  - Parking brake - does it hold car firmly?
  - Brake lines and hoses - cracking, softening, etc., leaking
  - Chassie: Loose wheel bearings, worn ball joints, worn steering parts, defective shock absorbers, sagged springs, etc., that might affect braking action.
- Look for malfunctions in brake warning light operation, pedal reserve, pedal action, braking behavior, and braking noise.
- Road Test.

PERFORMANCE STANDARDS (Con't.):

- Drive the vehicle to test brake action. The vehicle should stop quickly, smoothly, and with no tendency to dive or pull to the side.

SUGGESTED INSTRUCTION TIME: 4 Hours

RELATED TECHNICAL INFORMATION:

- Safety precautions while testing vehicle with possible brake problems.
- Brake pedal reserve.
- Vehicle braking during an emergency stop.

# UNIT 12

# AUTOMOTIVE SERVICING

UNIT 12.0 AUTOMOTIVE SERVICING

NARRATIVE SERVICE OR REPAIR AUTOMOBILES

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## PERFORMANCE OBJECTIVE:

Upon satisfactory mastery of the necessary basic automotive mechanics theory, given instruction in servicing, a vehicle or vehicle mock-up or system component to service, necessary tools, equipment, replacement parts, and manufacturer's shop data or manual, and help if needed; demonstrate the minimum required competency level of skills and knowledges required of an apprentice in inspecting, testing, adjusting, repairing, and replacing components in the process of diagnosing and repair (trouble-shooting) of automotive systems in simulated or actual servicing situations.

## PERFORMANCE ACTIONS:

Performance actions (enabling objectives) should be those outlined in this Articulated, Performance-based Instruction Guide for Automotive Mechanics if not superseded by the manufacturer's service information or the instructor.

## PERFORMANCE STANDARDS:

Satisfactory performance of the service or repair task undertaken.

The performance demonstrated should meet the standards outlined in the Articulated Guide for the appropriate tasks if not superseded by manufacturer's specifications or instructor's standards.

Meeting manufacturer's specifications and following manufacturer's procedures for service and repair will be emphasized.

Half-way repair jobs will not be accepted. If the customer insists on shortcuts to save a few pennies, the job should be refused. Emphasis will be on doing the service or repair "right" or not at all.

## SUGGESTED INSTRUCTION TIME:

Performance time must meet instructor's standards.

Performance time for service or repair may be estimated by considering the combined times of applicable tasks and using "Flat Rate Manual" (e.g., Flat Rate + 50 percent). In addition, performance time must consider the training equipment available.

## RATIONAL FOR AUTOMOTIVE SERVICING:

Automotive mechanics servicing provides the opportunity where the student can apply theoritical training and practice to simulated or actual service or repair situations.

Shop jobs are coordinated as closely as possible with theoritical training so that the student logically moves from the study of the fundamentals to practical exercises and finally to performance testing.

Typically, students can bring or accept any type of service or repair job where instruction has been given. Sometimes, however, the automotive training program must take advantage of "service or repair opportunities" that may not be repeated at a later date and, under the supervision of the instructor, basic instruction and service or repair are conducted together in a live situation.

Generally, the production of the automotive mechanics student in the training lab (shop) situation will be low and slow compared to industry because the primary aim is on teaching. Emphasis in shop servicing or repair work is placed on developing correct skills for automotive mechanics work. A job not done "right" may have to be done over by students.

Automotive mechanics shop servicing and repair work, however, provides a unique opportunity for students to encounter, in a controlled setting, day-to-day servicing or repair problems that cannot be simulated. The "hands-on" work in the shop provides learning experiences that only can be acquired through trial-and-error.

Worthwhile training projects, however, require more instructor planning. Careful scheduling is necessary to ensure that students are competent to accomplish the job within given times and resources. In addition, shop jobs must be arranged in the proper instructional sequence so that student teams can complete the job and so that service or repairs proceed properly.

Practical learning opportunities in the shop may be designed for special needs students, for the career interests of students, or to meet the needs of potential employers at a particular time. A secondary student already working in the automotive servicing field may be able to specialize in one or more fields through "additional experiences" in shop servicing and repair.

Shop servicing and repair provides the instructor with an optimum situation in which to test student knowledges and skills in realistic, "hands-on" examinations. In some situations, the shop job may be utilized by the instructor as a method of conducting a final examination to a unit or units of instruction.

A side benefit that often accompanies shop servicing and repair work is when students tend to develop good work habits and attitudes in addition to increasing their technological knowledges and skills in automotive mechanics.

# SUGGESTIONS

# FOR

# SHOP SERVICE

1. Organized diagnosis and testing procedures should be used to identify the specific service needed and to provide educational experiences for students.

2. Each service job may begin with a clear, concise written repair order. Service should observe Federal, State, and local requirements.

3. Service or repair should not begin until a specific repair order and a deposit to cover costs of parts or materials has been obtained. The educational organization should not be expected to pay unpaid service expense from training budgets.

4. All service work undertaken should be compatible with the curriculum objectives and students should not undertake work until being introduced to the appropriate theory.

5. Each service job should have appropriate check points established and work should not progress beyond certain check points until the work has been reviewed.

6. Automobiles to be serviced in the shop should be protected with fender covers, front seat, and floor protection and the steering wheel should be wiped clean after servicing.

7. Students should be able to describe the objectives and purposes of the specific service jobs they are to perform.

8. Keep a record or log of all parts and materials (lubricants, etc.) used in servicing or repairing a vehicle.

9. Students should record their time involved in repair or service and their name on the service order.

10. Students should not enter a vehicle except to perform authorized service. Only students assigned to the service job should be in the service area (near a vehicle).

11. Radios or audio equipment or accessories on vehicles should not be operated.

12. No work should be done under a vehicle unless proper safety procedures are followed.

13. Students should not raise a vehicle on the lift until the instructor has checked its position.

14. A vehicle engine should not be started after service or repair has been made until the instructor is present. Once serviced and parked for pickup, a vehicle should not be moved without direction from the instructor.

15. All service and repair work should be checked by the student or a student Acting Service Foreman and approved by the instructor.

16. The vehicle should be cleaned of possible grease or soil deposited during service or repair.

17. A service or repair job must not be rushed and half-way repair work should be refused.

18. Only students with a driver's license should drive a vehicle.

19. Prior to releasing a vehicle, the instructor should verify the service or repair and should obtain a limited release of responsibility from the customer.

Adopted from:

Henderson, W. E., Automotive Mechanics Program Guide, 1970 (unpublished).

Standards for Vocational Automotive Service Instruction, Detroit, MI: Motor Vehicle Manufacturer Association of the United States, Inc., p. 58, 1970.

## TOOL ROOM WORKER

(OPTIONAL)

Practical activities in secondary automotive mechanics typically includes related training and experience in such areas as the shop (lab) tool room. Some purposes that may be served by assigning the student to tool room duty on a rotating basis include the following:

1. Assigning the student to periodic duty in the tool room, on a rotating basis, provides a means of controlling valuable public property, essential to the conduct of training.

2. Through tool room duty, the student learns responsibility.

3. Tool room duty can contribute directly to a reduction in damaged or missing tools and equipment. Misuse of tools and equipment can be identified and a student can be held responsible for the loss of training tools and equipment.

4. Through maintaining a log of all tools and equipment signed out and returned, there will be a current inventory of the tool and equipment room. Tools and equipment in use or borrowed can be identified as to location and user.

5. The activities of the tool room duty student should include identifying tools and parts by their proper names; proper storage of tools, equipment, and parts; and inspection, cleaning, and care of tools and equipment. This task should include a regular inventory of tool boxes and kits to identify missing or unservicable components.

6. In addition, the tool room duty student may be assigned the task of observing the lab (shop) area to assist the instructor in identifying possible safety infractions and in fire prevention.

   The tool room duty student should take preventive action to prevent obstructed aisles and cluttered storage areas that might cause injury to others.

   The tool room duty student should aid fellow students in following prescribed safety practices of the shop. For example, the student might remind others concerning the use of safety stands, safety eye goggles, etc.

   The tool room duty student should observe the shop for potential fire hazards. The tool room duty student should assist in recovering oily rags and waste material in proper containers and seeing that flammable solvents, oil, paint, and chemicals are stored in a fireproof area.

The tool room duty student should be prepared to notify the instructor of questionable situations, locate and use fire extinguishers, and assist students in cases of accidents such as minor cuts, and eyes that require washing.

7. The knowledges and skills of the student assigned to tool room duty might be expanded through individualized study concerning the duties of the Auto Parts Counter Worker. (See accompanying description.)

# INDIVIDUALIZED STUDY

## AUTO PARTS COUNTER WORKER

(OPTIONAL)

If tool room duty for each student on a rotating basis is used in the secondary automotive mechanics program, the student has a unique opportunity to expand his/her vocational career awareness and preparation in automotive servicing through "Individualized Study" of AUTO PARTS COUNTER WORKER as a career option.

While assigned to tool room duty, individualized study can be programmed so that the student will learn career opportunities in and some duties of the Auto Parts Counter Worker.

Individualized training in Auto Parts Counter Worker should build on and reinforce the student's study of the basic systems and components of the automobile. If time and interest existed, training might be expanded to include ordering, stocking, inventorying, and selling replacement parts and accessories.

Adequate information exists to help the instructor provide individualized study material for the student. Several commercially available publications, recognized in the field, are described in this unit. These are available from the Articulation Coordinator on a two-week library loan. The publications described in this unit outline the parts counter worker's tasks and the knowledge requirements for job success. The material includes information on the systems and components of the automobile, how to use shop catalogs, parts counter mathematics as well as sample test questions including a fill-in-the-blank section that could be modified for self-paced instruction.

Instructors may wish to consult the publications mentioned in this unit for resource information (objectives and training aids) in the instruction on use of shop catalogs.

# AUTO PARTS COUNTER WORKER

## (OPTIONAL)

## RESOURCES

Notgrass, Troy., *Auto Parts Counter Worker*. Student's Manual, Austin, TX: The University of Texas at Austin (Instructional Material Center, Continuing Education), 1979. ($18.50)

Notgrass, Troy., *Auto Parts Counter Worker*, Coordinator's Guide, Austin, TX: The University of Texas at Austin (Instructional Materials Center, Continuing Education), 1975. ($10.95)

*Automotive Wholesaler Counterman's Handbook*, Chicago, IL: Automotive Service Industry Association, 1977. ($7.00)

*Study Plan for Automotive Wholesaler Counterman's Handbook*, Chicago, IL: Automotive Service Industry Association, 1977. (nc)

*Answers to Check Point Questions, Automotive Wholesaler Counterman's Handbook*, Chicago, IL: Automotive Service Industry Association, 1977. (nc)

SOURCES:

Center for Occupational Curriculum Development
Continuing Education
The University of Texas at Austin
Main Building 2400
Austin, TX 78712

Automotive Service Industry Association
444 North Michigan Avenue
Chicago, IL 60611

# ACTING SHOP FOREMAN

# WRITE-UP MAN

(OPTIONAL)

If this optional task area is elected by the instructor, one student, on a rotating basis, may be assigned to assist the instructor as Acting Shop Foreman and/or Write-up Man.

## ACTING SHOP FOREMAN

As Acting Shop Foreman, the student could assist the instructor in monitoring practical work activities underway in the automotive shop (lab). The student could serve as an additional service team member when needed by fellow students engaged in service work, might help the instructor monitor safety practices and fire prevention in the shop, might perform quality control inspections of jobs completed, or could assist fellow students in completing assigned service work on schedule.

The duties of the Acting Shop Foreman should not be supervisory in nature and clearly should be understood as related training designed to assist the instructor and fellow students.

## WRITE-UP MAN

An additional duty, the Acting Shop Foreman might serve as the Write-up Man also. This job could be assigned individually to a student if sufficient service work was being accomplished in the automotive shop (include student work on personal vehicles).

The write-up activity, preferably using a special clipboard and forms, should add a professional touch to the automotive mechanics training shop (lab).

The Write-up Man might be assigned the task of collecting minor shop fees, if applicable. (NOTE: Charges for parts probably should be handled by the instructor).

The Write-up Man should be responsible for writing a description of the service problem or activity including a possible diagnois and specifying specific correction actions requested or needed. To accomplish the task of Write-up Man, the student should be familiar with or have available reference information concerning automotive systems and components.

If the activities of the shop do not justify a student being assigned rotating duties as Acting Shop Foreman or Write-up Man, the tasks might be combined with the duties of the Tool Room Worker.

# DIESEL ENGINE THEORY

# and

# SERVICING DIESEL FUEL INJECTION SYSTEMS

# (OPTIONAL)

## INTRODUCTION

This unit on diesel engine theory and (diesel) fuel injection system servicing is included for optional automotive mechanics training at the secondary level.

Currently, two of the four secondary vocational automotive mechanics programs have some diesel engine training equipment and tools.

At the secondary level, theory of the diesel engine is introduced as part of instruction concerning internal combustion engines or as a separate subject.

Practical training (optional) may include disassembly and reassembly of diesel engines or components parts, preventive maintenance scheduling and limited troubleshooting of diesel systems.

Graduates of Automotive Mechanics at the secondary level should have acquired the necessary theory of internal combustion engine fundamentals to continue their career development in specialized diesel training courses at Greenville Technical College.

# DIESEL ENGINE THEORY

## (OPTIONAL)

## NARRATIVE

Upon completing orientation training on the diesel engine, the secondary Automotive Mechanics graduate should be able to identify the similarities and differences between a conventional spark-ignition engine and a diesel engine. The graduate should be able to identify the fuel-injection system and explain how the speed of the diesel engine is controlled by controlling the amount of fuel injected. The student will be able to start, run, and stop a diesel engine (mock-up, stand-mounted or vehicle mounted engine). The graduate will be able to locate and use emergency shut-down levers and controls and the graduate will be able to describe the basic safety precautions to take when working on diesel engines or fuelinjection systems.

Emphasis will be on theory and orientation (familiarization) training on the diesel engine.

# SERVICING THE DIESEL FUEL INJECTION SYSTEM

## (OPTIONAL)

Upon completion of this optional unit on diesel fuel-injection systems, the secondary Automotive Mechanics graduate should be able to identify a mechanical fuel-injection system (such as found on older Corvette cars) and electronic fuel-injection systems. On an electronic fuel-injection system, the student should be able to identify the ECU (electronic control unit), the various sensors, and the fuel lines and nozzels.

Performance orientation training may include the following tasks.

## TASK LISTINGS
(Possible Performance Tasks)
AUTOMOTIVE MECHANICS

| UNIT/TASK | DESCRIPTION |
|---|---|
| Unit 13.0 | SERVICING DIESEL FUEL-INJECTION SYSTEM |
| 13.01 | (Adjust Engine Idle) Given a diesel engine in running condition, socket set, pliers, screwdrivers, tachometer, and manual; adjust engine idle. When running, the engine idle must be +/- 25 RPM of manufacturer's specifications. |
| 13.02 | (Bleed Fuel System) Given a diesel engine in running condition, priming pump with gauge, screwdriver, pliers, combination wrench and manual; bleed the fuel system. Upon running engine, fuel must flow into setting bowl without interruption. |
| 13.03 | (Clean Injector) Given a diesel injector, clean diesel, compressed air, drill wire, lapping block, container, and manual; disassemble and clean all parts of the injector. All parts must be free of oil, dirt, and contaminates. |
| 13.04 | (Replace Fuel Injector) Given a diesel engine, combination wrench, socket set, torque wrench, screwdriver, new injector, clean diesel fuel, and manual; replace the fuel injector. Upon completion of the task, the injector must be aligned in the bore without damage to the injector. |
| 13.05 | (Install and Time Fuel-Injection Pump) Given a diesel engine, a socket set, scraper, feeler gauge, screwdrivers, Allen wrench set, and manual; install and time the fuel injection pump. The engine must run smoothly at +/- 25 RPM of the manufacturer's specifications. |

UNIT 13.0 SERVICING DIESEL FUEL INJECTION SYSTEM - LEVEL III

TASK 13.01 ADJUST ENGINE IDLE

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PERFORMANCE OBJECTIVE:

Given a diesel engine in running condition, socket set, pliers, screwdrivers, tachometer, and manual; adjust engine idle. When running, the engine idle must be to +/- 25 RPM of manufacturer's specifications.

PERFORMANCE ACTIONS:

13.0101 Ensure that all mechanical linkages are correctly adjusted.

13.0102 Locate engine idle screw adjustment.

13.0103 Set proper idle speed.

13.0104 Lock all adjustment screws securely.

PERFORMANCE STANDARDS:

- Adjust engine idle on a given diesel engine so that idle is +/- 25 RPM of manufacturer's specifications.

SUGGESTED INSTRUCTION TIME: 1 Hour

| | | |
|---|---|---|
| UNIT | 13.0 | SERVICING DIESEL FUEL INJECTION SYSTEM - LEVEL III |
| TASK | 13.02 | BLEED FUEL SYSTEM |

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PERFORMANCE OBJECTIVE:

Given a diesel engine in running condition, priming pump with gauge, screwdriver, pliers, combination wrench and manual; bleed the fuel system. Upon running engine, fuel must flow into setting bowl without interruption.

PERFORMANCE ACTIONS:

13.0201 Disconnect battery before working on system.

13.0202 a. If system uses a "Schrader" bleed valve, use it. (See 3 below.)
b. If system does not use "Schrader" bleed valve, crack (barely loosen a fitting.) (See 3 below).

13.0203 Cover the schrader valve or fitting with a shop cloth to catch and contain any fuel that may spray out.

13.0204 Dispose of the gas-soaked cloth properly.

ALTERNATE ACTIONS:

1. Attach priming pump with gauge attachment into inlet side.
2. Plug off fuel return line to fuel tank.
3. Pump clean fuel into engine fuel system.
4. Purge air from line.
5. Remove plug from fuel return line.
6. Remove priming pump and reconnect all lines previously disconnected.
7. Start engine and inspect for proper running.

PERFORMANCE STANDARDS:

- Bleed fuel system, taking necessary safety precautions.

SUGGESTED INSTRUCTION TIME: 2 Hours

UNIT 13.0 SERVICING DIESEL FUEL INJECTION SYSTEM - LEVEL III

TASK 13.03 CLEAN INJECTOR

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PERFORMANCE OBJECTIVE:

Given a diesel injector, clean diesel, compressed air, drill wire, lapping block, container, and manual; disassemble and clean all parts of the injector. All parts must be free of oil, dirt, and contaminates.

PERFORMANCE ACTIONS: (Typically for 1979 and early models.)

13.0301 Clean exterior of the injector.

13.0302 Dry injector.

13.0303 Disassemble injector and place parts in clean diesel fuel.

13.0304 Inspect and clean all parts.

13.0305 Clean injector tip holes.*

13.0306 Lap parts.

13.0307 Place cleaned parts in a separate pan of clean diesel fuel.
(*NOTE: After 1979 models, replace rather than clean injectors.

PERFORMANCE STANDARDS:

- Clean injector so that all parts are free of all oil, dirt, and contaminates. *(See above.)
- Check injector for leaks, opening pressure, spray pressure, chatter, spray jet shape, etc.

SUGGESTED INSTRUCTION TIME: 2 Hours (Injector cleaning)

RELATED TECHNICAL INFORMATION:

- WARNING: Do not point an injector nozzle towards your body when conducting tests. Spray leaving the nozzle has enough force to penetrate through the flesh. Wear protective goggles!

UNIT 13.0 SERVICING DIESEL FUEL INJECTION SYSTEM - LEVEL III

TASK 13.04 REPLACE FUEL INJECTOR

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PERFORMANCE OBJECTIVE:

Given a diesel engine, combination wrench, socket set, torque wrench, screwdriver, new injector, clean diesel fuel, and manual; replace the fuel injector. Upon completion of the task, the injector must be aligned in the bore without damage to the injector.

PERFORMANCE ACTIONS:

13.0401 Disconnect fuel lines to injector.

13.0402 Cap all disconnected lines.

13.0403 Remove the injector hold-down clamp bolt, special washer, and clamp.

13.0404 Clean injector hole.

13.0405 Install new injector in hole.

13.0406 Replace injector hold-down clamp and torque.

13.0407 Uncap fuel lines and connect to injector. Bleed lines.

13.0408 Torque lines.

PERFORMANCE STANDARDS:

- Replace fuel injector. Upon completion, the injector must be aligned in the bore without damage to the injector.

SUGGESTED INSTRUCTION TIME: 1 Hour per injector.

UNIT 13.0 SERVICING DIESEL FUEL-INJECTION SYSTEM - LEVEL III

TASK 13.05 INSTALL AND TIME FUEL-INJECTION PUMP

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PERFORMANCE OBJECTIVE:

Given a diesel engine, a socket set, scraper, feeler gauge, screwdrivers, Allen wrench set, and manual; install and time the fuel-injection pump. The engine must run smoothly at +/- 25 RPM of the manufacturer's specifications.

PERFORMANCE ACTIONS:

13.0501 Examine new pump making sure that the outside of the pump is clean.

13.0502 Clean fuel pump mounting area on engine.

13.0503 Rotate engine over until number one piston is at the top, dead center of the compression stroke.

13.0504 Rotate fuel pump until the mark on the drive coupling and the mark on the housing are in alignment.

13.0505 Place injection pump on the support bracket.

13.0506 Install hold-down bolts.

13.0507 Start cap screws in coupling.

13.0508 Tighten coupling securely and check clearance between coupling and drive disc.

13.0509 Inspect timing marks and safety-wire the coupling capscrew.

PERFORMANCE STANDARDS:

- Install and time fuel pump on a given diesel engine.
- Upon completion, the engine must run smoothly at +/- 25 RPM of the manufacturer's recommendations.

SUGGESTED INSTRUCTION TIME: 4 Hours

END OF
TRAINING TASK

CAREER OPPORTUNITIES

IDENTIFY POST-SECONDARY CAREER DEVELOPMENT OPPORTUNITIES

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PERFORMANCE OBJECTIVE:

Given an orientation to similar post-secondary vocational education programs, primarily the Automotive Mechanics program at Greenville Technical College and evening development programs for the automotive mechanics trade, a report of skill competencies development during secondary training and information as necessary; identify post-secondary career development opportunities.

PERFORMANCE ACTIONS:

1. Identify:
   a. Need for additional training at the post-secondary level.
   b. Benefits from additional training.
2. a. Identify post-secondary training programs available at GTC.
   b. Identify how post-secondary (GTC) training differs from secondary training in automotive mechanics.
3. Visit GTC program of possible interest. Talk with instructor, department head, or admissions counselor at GTC.
4. Determine with secondary and post-secondary assistance if exemption of post-secondary level training is recommended.
5. Accomplish the required steps to apply or test for exemption. (Optional)

PERFORMANCE STANDARDS:

- Identify post-secondary training opportunities in automotive mechanics or a related area at GTC.

SUGGESTED INSTRUCTION TIME: Typically, integrated throughout entire program.

## CONCLUDING REMARKS

The automotive industry is in the process of rapid change due to such factors as the supply and cost of fuel, environmental and population considerations, the challenge to American automobile manufacturing by foreign competitors, and increasing technological advances. The automotive mechanic must be prepared to maintain proficiencies as technological changes occur.

Some technological advances will be easy to adapt to since the changes primarily will involve manipulation or control of physical components according to available service data and manuals using special tools and service procedures.

Other technological changes may be more complex such as the movement from mechanical to electronic and microcomputer control components. The increasing use of advanced electronics or complex hydraulic systems emphasized the necessity for the successful automotive mechanic to possess a sound theory background probably including some fundamental knowledge in physics, chemistry, and electronics.

Automotive servicing and repair is developing into a specialized business and it appears that this trend will increase the necessity for the secondary level automotive mechanics graduate to consider specilization and probably further career development at the post-secondary technical college level. It appears that continuing education has become a requirement for the professional automotive mechanic to keep pace with the changing automotive servicing and repair industry.

The Automotive Mechanics Task Force Committee realizes that there is a limit to the degree of training that may be accomplished in a one or two year vocational education program. Secondary program emphasis will be on preparing graduates with the fundamental theory and basic skills for skilled entry level employment in the automotive service industry. Secondary graduates, however, will be encouraged to continue their career development or specialization at the post-secondary level or through continuing education once employed.

The requirement for vocational training which is responsive to the needs of the automotive service industry will continue to increase. As the local automotive service industry grows, South Carolina, at some time in the future, may follow the nationwide movement toward licensing or certification of automotive mechanics as a means of increasing the minimum competency level and some degree of accountability.

Based on the above consideration, it is apparent that the secondary level of automotive mechanics training should continue to emphasize a strong program in the fundamentals and basic skills of automotive mechanics. There will be the continuing need to validate the secondary objectives and standards through input from the local automotive service industry, possibly utilizing existing local "Curriculum Advisory Committees." At the post-secondary level, there will be a continued need to provide an initial training program as well as career development training for those persons proficient in the fundamentals or already employed in the automotive mechanics field.

Continuing secondary and post-secondary automotive mechanics vocational education programs are essential to promoting an educationally efficient continuum of learning for each student, within a framework of opportunity of all students, so that the financial and educational wasteful duplication of training is reduced.

"As automotive technology increases, fewer dealers will be willing to keep mechanics on the payroll for one or two years of training when they can employ a competent worker already trained to service the latest model vehicles. To provide the needed trained mechanics will take both the secondary and post-secondary vocational programs working hand-in-hand to serve the automotive service industry."

# PROFICIENCY REPORT

# PROFICIENCY REPORT
for

______________________________
Vocational Course

Student: ______________________________

High School: ______________________________

Vocational Center: ______________________________

Date Training Initiated: ____________
First Year Completed: ____________
Second Year Initiated: ____________
Second Year Completed: ____________

Instructor: ______________________________

DIRECTIONS: The purpose of the proficiency report is to communicate to the student, other instructors, or potential employers the abilities that a student has demonstrated to the instructor in vocational training. Mark each task as soon as possible after instruction or skills demonstrated. If instruction is not aimed as task proficiency, or if only an orientation or introduction to the task was provided, DO NOT mark a proficiency level or mark Level 0. Levels 1-4 indicate that instruction was given and the proficiency may be interpreted as follows:

| | |
|---|---|
| Level 0 | No skill level demonstrated or proficiency training not given in the skill. |
| Level 1 | Individual's skill level is not that generally expected for entry level employment. |
| Level 2 | Individual's skill level probably is that generally expected for entry level employment, but the individual probably will need close on-the-job supervision for a while longer. |
| Level 3 | Individual's skill level is that generally expected for entry level employment. |
| Level 4 | Individual's skill level is equal to that of a worker with some on-the-job experience. |

For further description of the levels of proficiency, see the "Credentialing Process and Proficiency Report" section of the Policies and Procedures Guide for Articulation Between The School District of Greenville County and Greenville Technical College.

## PROFICIENCY EVALUATION AID

This descriptive aid is designed to possibly assist the Automotive Mechanics instructor in standardizing the proficiency evaluation of students.

| PROFICIENCY | LEVEL 0 | LEVEL 1 | LEVEL 2 | LEVEL 3 | LEVEL 4 |
|---|---|---|---|---|---|
| Description | No skill level demonstrated or proficiency training not given in the skill. | Individual's skill level is not that generally expected for entry-level employee. | Individual's skill level probably is that expected for entry-level employment, but the individual probably will need close on-the-job supervision for a while longer. | Individual's skill level is that generally expected for entry-level employment. | Individual's skill level is equal to that of a worker with some on-the-job experience. |
| Tools and Equipment | " | Careless with tools and equipment | Used tools and equipment correctly most of the time. | Correctly used tools and equipment at all times. | Correctly used and cared for tools and equipment at all times |
| Materials and Parts | " | Wasteful and careless with materials parts... | Wasteful with materials and parts at times. | Usually careful with materials and parts. | Conserved materials and parts at all times. |
| Method of Service and Repair | " | Used own methods; "trial and error". | Made poor use of methods shown. | Followed correct methods most of the time. | Used demonstrated methods. |
| Accuracy to Specifications | " | Failed to meet specifications. | Work is approximately correct. | A few specifications are off. | Meets all specifications. |
| Working time | " | Little or no effort made to use time wisely. | Time used fairly well. | Wasted small amount of time. | Used time to best advantage. |
| Work and Work Station Apperance | " | Disassembly and assembly work poorly done; clean up not done. | Not very neat disassembly and assembly. | A few final touches needed for proper disassembly/assembly. | Work and station clean, neat, and professional in appearance. |
| Followed Shop Manuals and Procedures | " | Ignored procedures in manuals, etc. | Some steps wrong or omitted. | A few minor steps or procedures overlooked. | No corrections or recommendations necessary; accurate in procedures. |
| Problem-solving Ability | " | Solved no problems. | Solved only easy problems. | Solved nearly all problems. | Solved all problems. |
| Safety on the Job | " | Careless or ignores safety procedures and practices. | Not consistent in demonstrating safety consciousness and practices. | Observes minor safety procedures and practices most of the time. | Demonstrate safety consciousness and practices all the time. |
| Inspecting and Diagnosing | " | Incorrectly or poorly inspected and diagnosed malfunctions. | Successfully inspected simple situations; diagnosed only easy problems. | Accurate most of time; correcly diagnosed most problems. | Correct and accurate all of time. |
| R/R Components or Systems | " | Required supervision and help in R/R of systems/components. | Needed some supervision to R/R components/systems. | R/R systems/components with minor suggestions. | Able to satisfactorily R/R components and systems as assigned. |

Name ______________________ Year ______________

Section ______________ Instructor ______________

## PROFICIENTY REPORT

## AUTOMOTIVE MECHANICS

| | | Proficiency Level 0 | Level 1 | Level 2 | Level 3 | Level 4 | Date Completed | Instructor's Initials | Student's Initials |
|---|---|---|---|---|---|---|---|---|---|
| UNIT 1.0 | INTRODUCTION TO AUTOMOTIVE MECHANICS | | | | | | | | |
| 1.0 B | Demonstrated an understanding and working knowledge of safe practices in the shop. ( ) written test ( ) shop work | | | | | | | | |
| 1.0 F | Demonstrated proper selection, use, and maintenance of various hand tools used in shop. ( ) written test ( ) shop work | | | | | | | | |
| 1.0 F | Demonstrated proper selection, use, and maintenance of various power tools used in the auto shop. ( ) written test ( ) shop work | | | | | | | | |
| 1.0 H | Used shop manuals and technical publication handbooks, wiring diagrams, diagnosis manuals, Motors, Chilton and Glenn service manuals. ( ) written test ( ) shop work | | | | | | | | |
| 1.0 E | Used math skills for calculations involved in automotive service work. ( ) written test ( ) shop work | | | | | | | | |
| 1.0 E | Demonstrated ability to follow job procedures and completed job forms and records. ( ) written test ( ) shop work | | | | | | | | |
| 1.0 E | Identified ten different local service jobs and the training needed. | | | | | | | | |
| 1.0 I | ENGINE SYSTEMS/SERVICE | | | | | | | | |
| | Performed cylinder leakage test. | | | | | | | | |
| | Performed cylinder compression test. | | | | | | | | |
| | Performed power balance test. | | | | | | | | |
| | Performed valve cleaning and inspection. | | | | | | | | |
| | Performed valve facing and rocker arm service. | | | | | | | | |
| | Performed valve seating and assembly. | | | | | | | | |
| | Performed valve guide wear checking methods. | | | | | | | | |
| | R/R cylinder heads. | | | | | | | | |
| | Adjusted valves. | | | | | | | | |
| | Installed valve cover gaskets. | | | | | | | | |
| UNIT 2.0 | LUBRICATION SYSTEMS/SERVICE | | | | | | | | |
| | Performed lubrication service and minor safety check. | | | | | | | | |
| | Changed engine oil and/or filter. | | | | | | | | |
| | Lubricated front suspension and steering leakage. | | | | | | | | |
| | Adjusted and repaired front wheel bearings. | | | | | | | | |
| UNIT 3.0 | ENGINE MAINTENANCE, REPAIR, AND OVERHAUL | | | | | | | | |
| | Diagnosed needed engine repairs using vacuum tests. | | | | | | | | |
| | Dis/assembled and serviced major engine components. | | | | | | | | |
| | R/R engine components. | | | | | | | | |
| | R/R engine. | | | | | | | | |
| | Diagnosed engine component malfunctions. | | | | | | | | |
| UNIT 4.0 | FUEL SYSTEMS/SERVICE | | | | | | | | |
| | Adjusted carburetor and cleaned externally. | | | | | | | | |
| | Cleaned or replaced fuel filter. | | | | | | | | |
| | Inspected, serviced, or replaced carburetor air cleaner. | | | | | | | | |
| | Rebuild carburetor: 1 venturi | | | | | | | | |
| | 2 ventori | | | | | | | | |
| | 4 venturi | | | | | | | | |
| UNIT 5.0 | EMISSION CONTROL SYSTEMS/SERVICE | | | | | | | | |
| | Inspected exhaust components. | | | | | | | | |
| | R/R individual exhaust components. | | | | | | | | |
| | Demonstrated ability to safely use torch for heating and cutting. | | | | | | | | |

| | | Proficiency | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Level 0 | Level 1 | Level 2 | Level 3 | Level 4 | Date Completed | Instructor's Initials | Student's Initials |
| UNIT 6.0 A | COOLING SYSTEMS/SERVICE | | | | | | | | |
| | Inspected, adjusted, or replaced fan belts. | | | | | | | | |
| | Checked coolant freezing point. | | | | | | | | |
| | Pressure tested cooling system. | | | | | | | | |
| | Replaced heater hoses. | | | | | | | | |
| | Replaced radiator hoses. | | | | | | | | |
| | Chemically cleaned and flushed cooling system. | | | | | | | | |
| | R/R thermostat. | | | | | | | | |
| | Inspected water pump for mechanical malfunction. | | | | | | | | |
| | R/R water pump. | | | | | | | | |
| UNIT 6.0 B | HEATER SERVICE | | | | | | | | |
| | Diagnose heating system malfunctions. | | | | | | | | |
| | R/R water heater hoses. | | | | | | | | |
| | R/R water heater core. | | | | | | | | |
| UNIT 6.0 C | A/C SERVICE | | | | | | | | |
| | Pressure test and leak test AC system. | | | | | | | | |
| | Inspect/recharge A/C system with refrigerant. | | | | | | | | |
| | Check A/C system for satisfactory operation. | | | | | | | | |
| | R/R A/C components. | | | | | | | | |
| UNIT 7.0 A | BATTERY SYSTEMS/SERVICE | | | | | | | | |
| | Demonstrated ability to interpret battery ratings. | | | | | | | | |
| | Inspected and cleaned a battery. | | | | | | | | |
| | Tested a battery with a hydrometer. | | | | | | | | |
| | Tested a battery with a high rate discharge tester. | | | | | | | | |
| | Performed a 3-minutes battery test. | | | | | | | | |
| | Charged a battery. | | | | | | | | |
| | Hooked up jumper cables correctly. | | | | | | | | |
| UNIT 7.0 B | CHARGING SYSTEMS/SERVICE | | | | | | | | |
| | Performed charging voltage output test with a voltmeter and evaluated findings. | | | | | | | | |
| | Checked and adjusted alternator drive belt. | | | | | | | | |
| | Performed charging system output test. (Used shop job sheet) | | | | | | | | |
| | R/R alternator--generator. | | | | | | | | |
| | R/R regulator. | | | | | | | | |
| | Bench tested alternator and repaired as needed. | | | | | | | | |
| UNIT 7.0 C | STARTING SYSTEMS/SERVICE | | | | | | | | |
| | Performed starter current draw test. | | | | | | | | |
| | Performed cranking voltage test. | | | | | | | | |
| | Performed voltage drop test on starter cables. | | | | | | | | |
| | Performed voltage drop test and continuity test on relays, solenoid, neutral safety switch. | | | | | | | | |
| | Demonstrated ability to test armature and field windings with a growler. | | | | | | | | |
| | R/R starter. | | | | | | | | |
| UNIT 7.0 D | ELECTRICITY SYSTEMS/SERVICE | | | | | | | | |
| | Performed continuity test. | | | | | | | | |
| | Measured voltage drop across a component or connection. | | | | | | | | |
| | Measured current flow in a circuit. | | | | | | | | |
| | Measured resistance of a component. | | | | | | | | |
| | Tested a diode and evaluated finding. | | | | | | | | |
| | Soldered a splice and installed terminals and connectors. | | | | | | | | |
| | Set up headlamp alignment equipment and evaluated readings. | | | | | | | | |
| | Aligned headlamps. (single and/or dual) | | | | | | | | |
| | Performed operational inspection of lighting system. | | | | | | | | |
| | R/R flasher units. | | | | | | | | |
| | Located and repaired shorts and opens in electrical circuits. | | | | | | | | |

| | | Proficiency Level 0 | Level 1 | Level 2 | Level 3 | Level 4 | Date Completed | Instructor's Initials | Student's Initials |
|---|---|---|---|---|---|---|---|---|---|
| UNIT 7.0 E | IGNITION SYSTEMS/SERVICE | | | | | | | | |
| | R/R spark plugs, clean, gap, and test. | | | | | | | | |
| | R/R distributor points and condenser. | | | | | | | | |
| | R/R distributor. | | | | | | | | |
| | Removed and inspected distributor cap, rotor and cables. | | | | | | | | |
| | Tested coil polarity and voltage output. | | | | | | | | |
| | Demonstrated ability to trace a primary circuit. | | | | | | | | |
| | Demonstrated ability to trace a firing order. | | | | | | | | |
| UNIT 7.0 F | TUNE UP SYSTEMS/SERVICE | | | | | | | | |
| | Performed minor tune-up and adjust according to manufacture specifications using hand held test equipment: timing light, tach-dwell, vacuum gauge. | | | | | | | | |
| | Performed steps of major tune-up according to manufacturer specifications using an engine analyzer. | | | | | | | | |
| | Checked distributor functions with distributor tester (option). | | | | | | | | |
| | Performed infrared exhaust test and explained findings. | | | | | | | | |
| UNIT 8.0 A | POWER TRAIN SYSTEMS/SERVICE | | | | | | | | |
| | Changed rear axle lubricant. | | | | | | | | |
| | Inspected and repaired universal joint. | | | | | | | | |
| | R/R rear axle shaft and seal. | | | | | | | | |
| | R/R drive shaft. | | | | | | | | |
| Unit 8.0 B | TRANSMISSION, MANUAL | | | | | | | | |
| | Adjust a clutch. | | | | | | | | |
| | R/R clutch components. | | | | | | | | |
| UNIT 8.0 C | TRANSMISSION, AUTOMATIC | | | | | | | | |
| | Adjust and service automatic transmission. | | | | | | | | |
| | R/R automatic transmission and components. | | | | | | | | |
| | Overhaul automatic transmission. | | | | | | | | |
| UNIT 9.0 | TIRES AND WHEELS SYSTEMS/SERVICE | | | | | | | | |
| | Demonstrated knowledge of tire nomenclature. (test) | | | | | | | | |
| | Demonstrated ability to use tire changer: Manual | | | | | | | | |
| | Demonstrated ability to use tire changer: Automatic | | | | | | | | |
| | Performed tire balancing: Bubble | | | | | | | | |
| | Performed tire balancing: Spin | | | | | | | | |
| UNIT 10.0 | SUSPENSION SYSTEMS/SERVICE | | | | | | | | |
| | Lubricate suspension system. | | | | | | | | |
| | Performed pre-alignment inspection for defective parts. | | | | | | | | |
| UNIT 11.0 | BRAKES SYSTEMS/SERVICE | | | | | | | | |
| | Performed operational brake inspection. | | | | | | | | |
| | R/R drum brake assembly. | | | | | | | | |
| | Inspected and refinished brake drums. | | | | | | | | |
| | Repaired wheel cylinder. | | | | | | | | |
| | Replaced brake hoses, hydraulic lines, and fittings. | | | | | | | | |
| | R/R wheel cylinder. | | | | | | | | |
| | R/R master cylinder. | | | | | | | | |
| | Inspected and replaced disc brake pads. | | | | | | | | |
| | Inspected and refinished rotor. (Disc) | | | | | | | | |
| | Repaired disc brake caliper. | | | | | | | | |
| | Demonstrated correct procedure to bleed hydraulic brakes. | | | | | | | | |

|  |  | Proficiency |  |  |  |  | Date Completed | Instructor' Initials | Student's Initials |
|---|---|---|---|---|---|---|---|---|---|
|  |  | Level 0 | Level 1 | Level 2 | Level 3 | Level 4 |  |  |  |
| UNIT 12.0 | Performed LEVEL I service: Lubrication, tire repair, brake adjustment. |  |  |  |  |  |  |  |  |
|  | Performed LEVEL II service: Minor repairs and tune-ups, R/R minor components, minor adjustments... typical of apprentice mechanic with one year of experience. |  |  |  |  |  |  |  |  |
|  | Performed LEVEL III repairs such as over hauled automotive systems, tested and diagnosed system and component mal-functions. R/R: carburetor, trans-mission, engine, electrical-ignition systems, etc. Entry level mechanic with two years experience. |  |  |  |  |  |  |  |  |
|  | Narrative of Exact Skill Experiences of this Student: |  |  |  |  |  |  |  |  |
| UNIT 13.0 | Adjusted diesel fuel injection system. |  |  |  |  |  |  |  |  |
|  | R/R diesel fuel injection system injectors, Filters. |  |  |  |  |  |  |  |  |
|  | R/R and time fuel injection pump. |  |  |  |  |  |  |  |  |
|  | Calibrate diesel governor. |  |  |  |  |  |  |  |  |

Student: ____________________

## COMPETENCIES: SUMMARY CHECKLIST

| | | Proficiency Level 0 | Level 1 | Level 2 | Level 3 | Level 4 | Date Completed | Instructor's Initials |
|---|---|---|---|---|---|---|---|---|
| UNIT 1.0 | SAFETY, WORK PERFORMANCE AND ATTITUDES, TOOL AND EQUIPMENT | | | | | | | |
| 1.0-B | Practiced shop, personal, and fire safety and used power tools and machinery safety. | | | | | | | |
| 1.0-D | Demonstrated desirable job performance behavior such as punctual, dependable, and ambitious, neat, working without supervision, and following directions. | | | | | | | |
| 1.0-D | Demonstrated desirable work attitudes including: Cooperative, respectful, responsible, dependable, does share of work, pride in work, controls anger, accepts criticism, and works regularly. | | | | | | | |
| 1.0-E | Identified, properly used, and cared for common hand tools and measuring devices. | | | | | | | |
| 1.0-F | Identified and properly used common automotive shop machinery such as lifts, jacks, air compressors, grinders, etc. | | | | | | | |
| 1.0-F | Identified and properly used automotive fasteners | | | | | | | |
| 1.0-H | Properly used automotive manufacturer's manuals, flat rate manual, specifications, and parts catalogs. Able to use language of automotive service business. | | | | | | | |
| 1.0-I | Demonstrated knowledge of purpose, operation, major parts and care of major automotive systems including cooling, breaking, fuel, steering, front end, power train, transmission, engine, electrical, heater, and air-conditioning systems. | | | | | | | |
| UNIT 2.0 | LUBRICATION AND PREVENTATIVE MAINTENANCE | | | | | | | |
| 2.02 | Changed oil and filters. | | | | | | | |
| 2.02 | Lubricated vehicle and equipment. | | | | | | | |
| 2.03 | Inspected, serviced, or replaced carburetor air cleaner. | | | | | | | |
| UNIT 3.0 | ENGINE MAINTENANCE, REPAIR, AND OVERHAUL | | | | | | | |
| 3.01 | Diagnosed engine condition using vacuum gauge and specifications. | | | | | | | |
| 3.02 | Removed and replaced valve cover gasket. | | | | | | | |
| 3.03 | Replaced outside rear-main seal. | | | | | | | |
| 3.04 | Replaced motor mounts according to specifications | | | | | | | |
| 3.05 | Performed cylinder compression tests and determined needed repairs. | | | | | | | |
| 3.06 | Removed cylinder head(s) from engine. | | | | | | | |
| 3.07 | Disassembled cylinder head. | | | | | | | |
| 3.08 | Inspected valve spring retainers and locks for etchings, squareness, uniformity, and specified compression. | | | | | | | |
| 3.09 | Inspected valve guides for wear, checked valve guide to stem fit for specifications. | | | | | | | |
| 3.10 | Inspected cylinder head for cracks, gasket surface areas for warpage, and passage condition. | | | | | | | |
| 3.11 | Reassembled valve components with head according to specifications. | | | | | | | |
| 3.12 | Installed cylinder head(s) on engine block to specifications. | | | | | | | |
| 3.13 | Steam cleaned the engine surface of heavy deposits of dirt and grease without moisture damage to ignition parts or charging system. | | | | | | | |
| 3.14 | Visually checked exhaust system for holes, defects, broken or missing components, and rust outs. | | | | | | | |
| 3.15 | Removed and installed new exhaust, manifold, and eliminating possible leaks or rattles. | | | | | | | |
| 3.16 | Test positive crankcase ventilation system with pressure tester according to manufacturer's specifications. | | | | | | | |

|  |  | Proficiency |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|---|
|  |  | Level 0 | Level 1 | Level 2 | Level 3 | Level 4 | Date Completed | Instructor's Initials |
| 3.17 | Performed cylinder leakage test following manufacturer's procedures, within +/- 10 percent of findings of instructor. |  |  |  |  |  |  |  |
| 3.18 | Performed cylinder power balance test with findings +/- 10 percent of instructor's readings. |  |  |  |  |  |  |  |
| 3.19 | Examined valve train and head of operating engine and identified malfunctions with 100 percent accuracy. |  |  |  |  |  |  |  |
| 3.20 | Cleaned and inspected engine components for proper condition. |  |  |  |  |  |  |  |
| 3.21 | Performed operational inspections of engine lubrication systems following manufacturer's procedures. |  |  |  |  |  |  |  |
| 3.22 | Removed and replaced camshaft to specifications so the camshaft and component parts worked freely, without binding or leakage. |  |  |  |  |  |  |  |
| 3.23 | Removed and replaced intake manifold to specifications. |  |  |  |  |  |  |  |
| 3.24 | Adjusted exhaust and intake valve "lash" to specifications, detecting and correcting any variations. |  |  |  |  |  |  |  |
| 3.25 | Grind valve face and stem using valve machine in accordance with specifications. |  |  |  |  |  |  |  |
| 3.26 | Refaced valve seats using a valve seat grinder, maintaining a concentricity of .002 inch. |  |  |  |  |  |  |  |
| 3.27 | Knurl valve guides to a correct fit. |  |  |  |  |  |  |  |
| 3.28 | Removed and replaced oil pump following manufacturer's procedures with no leaks or malfunctions. |  |  |  |  |  |  |  |
| 3.29 | Replaced flywheel ring gear and flywheel by specifications and procedures so the flywheel ring gear functioned without noise or slippage. |  |  |  |  |  |  |  |
| 3.30 | Removed and replaced engine without incurring any damage to surrounding items and equipment and observing safety precautions. |  |  |  |  |  |  |  |
| 3.31 | Removed and replaced connecting rods and rod bearings, with no leaks in the repaired area, will oil pressure and engine temperature conform to specifications. |  |  |  |  |  |  |  |
| 3.32 | Removed and replaced crankshaft and bearings inspecting for proper fit with micrometers and plastigauge. |  |  |  |  |  |  |  |
| UNIT 4.0 | FUEL SYSTEM MAINTENANCE AND REPAIR |  |  |  |  |  |  |  |
| 4.01 | Removed and replaced fuel filter to specifications. |  |  |  |  |  |  |  |
| 4.02 | Diagnosed problem and serviced or repaired malfunctioning carburetor to specifications. |  |  |  |  |  |  |  |
| 4.03 | Adjusted carburetor to specifications setting idle +/- 50 RPM of specifications. |  |  |  |  |  |  |  |
| 4.04 | Inspected, cleaned, and adjusted automatic choke to manufacturer's tolerances. |  |  |  |  |  |  |  |
| 4.05 | Replaced carburetor by manufacturer's procedures setting idle speed +/- 50 RPM of specifications. |  |  |  |  |  |  |  |
| 4.06 | Removed, cleaned, and installed fuel filter by manufacturer's procedures with no leaks or stoppages in fuel system. |  |  |  |  |  |  |  |
| 4.07 | Removed, serviced, or replaced fuel lines or hoses on a given vehicle by manufacturer's procedures and to specifications. |  |  |  |  |  |  |  |
| 4.08 | Measured pressure and flow of fuel in fuel pump with 100 percent accuracy. |  |  |  |  |  |  |  |
| 4.09 | Removed and replaced fuel pump to specifications |  |  |  |  |  |  |  |
| 4.10 | Adjusted fuel injection system by electronic diagnostic equipment. |  |  |  |  |  |  |  |
| 4.11 | Inspected, serviced, or replaced fuel sending unit by manufacturer's procedures with dash indicator meeting specifications. |  |  |  |  |  |  |  |

| | | | Proficiency | | | | | Date Completed | Instructor's Initials |
|---|---|---|---|---|---|---|---|---|---|
| | | | Level 0 | Level 1 | Level 2 | Level 3 | Level 4 | | |
| | 4.12 | Removed fuel tank, cleaned moisture and dirt by manufacturer's procedures and reinstalled tank to specifications. | | | | | | | |
| | 4.13 | Removed carburetor bowl cover, inspected for dirt sediment and moisture, and cleaned carburetor as necessary following manufacturer's procedures. | | | | | | | |
| | 4.14 | Rebuilt carburetor with finished unit operating and adjusted to specifications with no leaks.<br>Type: ________ ________ ________ | | | | | | | |
| UNIT | 5.0 | EMISSION CONTROLS AND EXHAUST SYSTEM | | | | | | | |
| | 5.01 | Serviced PVC System. Type:<br>( ) PVC ( ) Smith Valve<br>( ) Orifice/metering ( ) Diaphragm/valve/gulp | | | | | | | |
| | 5.02 | Inspected exhaust system for leaks or damage. | | | | | | | |
| | 5.03 | Tested and adjusted idle solenoid.<br>( ) Check if done as part of carburetor or engine tune-up. | | | | | | | |
| | 5.04 | Checked and serviced fuel evaporation system. | | | | | | | |
| | 5.05 | Serviced, repaired, or replaced Thermostatic Air Cleaner. | | | | | | | |
| | 5.06 | Tested Air Injection Reactor System. | | | | | | | |
| | 5.07 | Tested and serviced Exhaust Gas Recirculation Valve and component operation. | | | | | | | |
| | 5.08 | Inspected and serviced Manifold Heat Control Valve. | | | | | | | |
| | 5.09 | Removed and replaced catalytic converter. | | | | | | | |
| | 5.10 | Inspected, removed, and replaced tail pipe or muffler. | | | | | | | |
| UNIT | 6.0A | COOLING SYSTEM MAINTENANCE AND REPAIR | | | | | | | |
| | A.01 | Checked and corrected coolant level to specifications. | | | | | | | |
| | A.02 | Inspected, adjusted, or replaced fan belts to specifications. | | | | | | | |
| | A.03 | Checked and tested radiator cap.<br>( ) Check if radiator pressure tester used. | | | | | | | |
| | A.04 | Tested cooling system thermostat for proper operation within 5 degrees F of accuracy. | | | | | | | |
| | A.05 | Pressure tested cooling system. | | | | | | | |
| | A.06 | Inspected and replaced water hoses by manufacturer's procedures. | | | | | | | |
| | A.07 | Checked coolant freezing point with tester within 5 degrees F of accuracy. | | | | | | | |
| | A.08 | Checked overflow tank for proper operating and mounting. | | | | | | | |
| | A.09 | Removed and replaced radiator by manufacturer's procedures with no leaks in finished unit. | | | | | | | |
| | A.10 | Chemically cleaned and flushed cooling system following manufacturer's procedures. | | | | | | | |
| | A.11 | Using chemical tester, performed chemical test on coolant system identifying all leaks within 1/2 hour by manufacturer's procedures. | | | | | | | |
| | A.12 | Replaced water pump by manufacturer's specifications so unit functions without leaks or stoppage. | | | | | | | |
| | A.13 | Replaced variable speed fan by manufacturer's procedures. | | | | | | | |
| | A.14 | Replaced core plug (freeze plug) by manufacturer's procedures. | | | | | | | |
| | A.15 | Solder minor, accessable leaks in radiator. | | | | | | | |
| UNIT | 6.0B | AUTOMOBILE HEATER MAINTENANCE AND REPAIR | | | | | | | |
| | B.01 | Performance tested heating system to identify malfunctions. | | | | | | | |
| | B.02 | Backflushed heating system (core) by manufacturer's instructions. | | | | | | | |
| | B.03 | Replaced defroster hose by manufacturer's procedures with no leaks in completed job. | | | | | | | |
| | B.04 | Replaced heater control unit so unit operates to specifications. | | | | | | | |
| | B.05 | Removed and replaced water heater core to specifications with no leaks or damage to heater. | | | | | | | |

|  |  | Proficiency Level 0 | Level 1 | Level 2 | Level 3 | Level 4 | Date Completed | Instructor's Initials |
|---|---|---|---|---|---|---|---|---|
| UNIT 6.0C | AUTOMOTIVE AIR CONDITIONER MAINTENANCE AND REPAIR |  |  |  |  |  |  |  |
| C.01 | Checked air conditioner for satisfactory operation. |  |  |  |  |  |  |  |
| C.02 | Discharged AC System. |  |  |  |  |  |  |  |
| C.03 | Replaced AC fan motor by manufacturer's procedures so motor operates correctly at all speeds with no rattles. |  |  |  |  |  |  |  |
| C.04 | Replaced AC receiver drier (dehydrator) to specifications so no air bubbles are in viewing glass. |  |  |  |  |  |  |  |
| C.05 | Replaced expansion valve on AC unit by manufacturer's procedures so unit functions properly with no leaks. |  |  |  |  |  |  |  |
| C.06 | Replace compressor seals to specifications with no leaks around seals. |  |  |  |  |  |  |  |
| C.07 | Replaced condenser assembly in AC unit. |  |  |  |  |  |  |  |
| C.08 | Replaced evaporator control valve or diaphragm in AC unit by specifications. |  |  |  |  |  |  |  |
| C.09 | Replaced AC compressor by manufacturer's procedures. |  |  |  |  |  |  |  |
| C.10A | Installed manifold gauge set on AC unit and compared pressure readings to manufacturer's specifications. |  |  |  |  |  |  |  |
| C.10B | Tested for refrigerant leaks in AC unit by manufacturer's specifications. |  |  |  |  |  |  |  |
| C.11 | Identified malfunctions in given AC unit with 100 percent accuracy within 1 hour. |  |  |  |  |  |  |  |
| C.12 | Repaired AC unit electrical circuit to specifications. |  |  |  |  |  |  |  |
| C.13 | Repaired vacuum circuits to specifications so AC unit functions properly with no leaks. |  |  |  |  |  |  |  |
| C.14 | Inspected and recharged AC system with refrigerant to specifications. |  |  |  |  |  |  |  |
| C.15 | Evaculated AC system so no coolant remainted. |  |  |  |  |  |  |  |
| UNIT 7.0 | ELECTRICAL SYSTEMS |  |  |  |  |  |  |  |
| 7.01 | Checked spark plugs and replaced them as necessary according to manufacturer's specifications. |  |  |  |  |  |  |  |
| 7.02 | Checked spark plug wiring to ensure that it meets specifications. |  |  |  |  |  |  |  |
| 7.03 | Cleaned and replaced distributor cap towers, wiring, and other minor electrical units for proper functioning to specifications. |  |  |  |  |  |  |  |
| 7.04 | Inspected, adjusted, removed, and replaced alternator belt so belt is servicable, at correct tension, and so alternator is securely replaced. |  |  |  |  |  |  |  |
| 7.05 | Checked battery voltage, and charge. Battery operation must be to specifications. |  |  |  |  |  |  |  |
| 7.06 | Checked operation of all exterior lights and control switches and determined if they were operational by specifications replacing bulbs, flashers, and fuses as necessary. |  |  |  |  |  |  |  |
| 7.07 | Tested and replaced fuses. |  |  |  |  |  |  |  |
| 7.08 | Replaced flasher units. |  |  |  |  |  |  |  |
| 7.09 | Adjusted backup light switches to working order. |  |  |  |  |  |  |  |
| 7.10 | Adjusted headlights to SC State requirements using Headlight Tester. |  |  |  |  |  |  |  |
| 7.11 | Set ignition timing within +/- 1 degree of specifications. |  |  |  |  |  |  |  |
| 7.12 | Replaced ( ) generator ( ) alternator to specifications so unit operates correctly without noise or shimming. |  |  |  |  |  |  |  |
| 7.13 | Replaced and tested starter. |  |  |  |  |  |  |  |
| 7.14 | Replaced starter solenoid. |  |  |  |  |  |  |  |
| 7.15 | Completed necessary repairs on ( ) alternator ( ) generator so units meets specifications. |  |  |  |  |  |  |  |

| | | Proficiency<br>Level 0 | Level 1 | Level 2 | Level 3 | Level 4 | Date Completed | Instructor's Initials |
|---|---|---|---|---|---|---|---|---|
| 7.16 | Isolate malfunction in cranking system and estimated repairs. | | | | | | | |
| 7.17 | Replaced and adjusted distributor to specifications. | | | | | | | |
| 7.18 | Identify defective electrical switches and replace them as necessary. | | | | | | | |
| 7.19 | Repaired malfunctioning windshield wiper mechanisms and controls by manufacturer's procedures. | | | | | | | |
| 7.20 | Repaired or replaced fuse box assembly. | | | | | | | |
| 7.21 | Replaced chassis and underhood wiring to specifications. | | | | | | | |
| 7.22 | Located malfunction in dash wiring, tested and repaired or replaced wiring. | | | | | | | |
| 7.23 | Analyzed cause of electrical malfunction and estimated repairs with 100 percent accuracy. | | | | | | | |
| 7.24 | Replaced ignition switch and resistor by manufacturer's manual. | | | | | | | |
| 7.25 | Evaluated ( ) alternator, ( ) generator, and ( ) regulator output accurately to determine its performance. | | | | | | | |
| 7.26 | Located the problem in a charging system regulator and repaired or replaced the component(s). | | | | | | | |
| 7.27 | Analyzed and adjusted engine performance using Engine Analyzer, to manufacturer's specifications. | | | | | | | |
| 7.28 | Strobed distributor and modified/corrected advance curves (checked timing and dwell angle and adjusted to specifications). | | | | | | | |
| 7.29 | Visually inspected secondary circuit lead wires, distributor cap, and rotor, and measured secondary wire resistance. | | | | | | | |
| 7.30 | Visually inspected ignition switch, resistor, wiring, and coil of primary circuit to determine if each unit was to specifications, identifying with 100 percent accuracy all malfunctions. | | | | | | | |
| 7.31 | Replaced coil of primary circuit. | | | | | | | |
| 7.32 | Located and repaired a ( ) short or ( ) open circuit. | | | | | | | |
| 7.33 | Isolated malfunction in transistor ignition system and repaired or replaced components as necessary. | | | | | | | |
| 7.34 | Inspected points and condenser using ohmeter to check specifications. | | | | | | | |
| 7.35 | Replaced ( ) points and ( ) condenser adjusting degrees of dwell within 2 degrees of specifications. | | | | | | | |
| 7.36 | Overhauled distributor and calibrated within +/- 2 degrees of specifications. | | | | | | | |
| 7.37 | Performed a complete engine "tune-up" so engine operated to manufacturer's specifications. | | | | | | | |
| UNIT 8.0 A | DRIVE TRAIN - LEVEL I | | | | | | | |
| 8.01 | Checked fluid levels in standard transmission | | | | | | | |
| 8.02 | Checked fluid levels in automatic transmission and fill to proper level | | | | | | | |
| 8.03 | Selected fluid for proper application (Lubricate) | | | | | | | |
| 8.04 | Inspected universal joints for wear or damage | | | | | | | |
| 8.05 | Lubricated U-joints | | | | | | | |
| 8.06 | Lubricated speedometer cable drive gear and housing | | | | | | | |

| | | | Proficiency Level 0 | Level 1 | Level 2 | Level 3 | Level 4 | Date Completed | Instructor's Initials |
|---|---|---|---|---|---|---|---|---|---|
| UNIT | 8.0 B | DRIVE TRAIN - LEVEL II | | | | | | | |
| | 8.01 | Adjusted a clutch | | | | | | | |
| | 8.02 | Repaired and replaced slip-joints, U-joints | | | | | | | |
| | 8.03 | Repaired, replaced, or adjusted front drive axle assemblies | | | | | | | |
| | 8.04 | Replaced manual transmission rear seal, gasket, and bushing (in car repairs) | | | | | | | |
| | 8.05 | Removed and replaced clutch, disc pressure plate, release (throwout) bearings, pilot bearings (bushing), and adjusted external shaft linkage on manual transmission | | | | | | | |
| | 8.06 | Replaced transmission mounts | | | | | | | |
| | 8.07 | Tested manual transmission operation | | | | | | | |
| | 8.08 | Replaced manual transmission | | | | | | | |
| | 8.09 | Rebuilt manual transmission | | | | | | | |
| | 8.10 | Replaced rear axle shaft, bearings, and seal | | | | | | | |
| | 8.11 | Replaced pinion seal | | | | | | | |
| | 8.12 | Diagnosed differential malfunctions | | | | | | | |
| | 8.13 | Repaired or replaced differential | | | | | | | |
| UNIT | 8.0 C | DRIVE TRAIN - LEVEL III | | | | | | | |
| | 8.01 | Performed operational tests on automatic transmission | | | | | | | |
| | 8.02 | Adjusted column-type linkage | | | | | | | |
| | 8.03 | Adjusted floor linkage | | | | | | | |
| | 8.04 | Adjusted linkage from engine to automatic transmission | | | | | | | |
| | 8.05 | Cleaned and visually inspected transmission | | | | | | | |
| | 8.06 | Diagnosed, replaced, or adjusted modulators | | | | | | | |
| | 8.07 | Serviced filter | | | | | | | |
| | 8.08 | Replaced or adjusted neutral safety switch | | | | | | | |
| | 8.09 | Made band adjustments (internal and external) | | | | | | | |
| | 8.10 | Removed and installed automatic transmission | | | | | | | |
| | 8.11 | Replaced external seals, gaskets, and lines on automatic transmission | | | | | | | |
| | 8.12 | Inspected, removed, and replaced converter | | | | | | | |
| UNIT | 9.0 | WHEELS AND TIRES | | | | | | | |
| | 9.01 | Removed and replaced tire, tube, and rim assembly | | | | | | | |
| | 9.02 | Repaired flat tire | | | | | | | |
| | 9.03 | Recognized both causes and remedies of abnormal tire wear | | | | | | | |
| | 9.04 | Performed front wheel bearing services, removed, cleaned, lubricated, replaced, and adjusted | | | | | | | |
| | 9.05 | Speed balanced wheels and tires | | | | | | | |
| | 9.06 | Diagnosed tire and wheel malfunctions | | | | | | | |
| UNIT | 10.0 | STEERING AND SUSPENSION | | | | | | | |
| | 10.01 | Lubricated front and rear suspension | | | | | | | |
| | 10.02 | Replaced belts and adjusted tension | | | | | | | |
| | 10.03 | Checked and corrected power-steering system fluid level and belt tension | | | | | | | |
| | 10.04 | Inspected steering linkage and ball-joints | | | | | | | |
| | 10.05 | Replaced tie rod end (ball socket) | | | | | | | |
| | 10.06 | Replaced idler arm | | | | | | | |
| | 10.07 | Removed and replaced shock absorbers | | | | | | | |
| | 10.08 | Removed and replaced McPherson strut assembly | | | | | | | |
| | 10.09 | Performed visual inspections of suspension system | | | | | | | |
| | 10.10 | Inspected and serviced front wheel bearing and grease seal | | | | | | | |
| | 10.11 | Inspected and diagnose steering and front suspension system problems | | | | | | | |
| | 10.12 | Replaced coil springs | | | | | | | |
| | 10.13 | Removed and replaced leaf springs | | | | | | | |

| | | Proficiency | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Level 0 | Level 1 | Level 2 | Level 3 | Level 4 | Date Completed | Instructor's Initials |
| 10.14 | Adjusted worm and sector in steering gear | | | | | | | |
| 10.15 | Repaired or replaced manual steering components | | | | | | | |
| 10.16 | Replaced power steering components | | | | | | | |
| 10.17 | Repaired tilt and telescoping steering wheel | | | | | | | |
| 10.18 | Inspected front suspension system | | | | | | | |
| 10.19 | Rebushed king pins | | | | | | | |
| 10.20 | Replaced ball-joints | | | | | | | |
| 10.21 | Replaced front suspension control arms and bushings | | | | | | | |
| 10.22A | Adjusted torsion bars | | | | | | | |
| 10.22B | Replaced torsion bars | | | | | | | |
| 10.23 | Balanced wheels and tires | | | | | | | |
| 10.24 | Removed and replaced steering spindle (ball-joint type) | | | | | | | |
| 10.25 | Inspected and aligned front end | | | | | | | |
| 10.26 | Inspected and serviced rear end | | | | | | | |
| UNIT 11.0 | BRAKING SYSTEM MAINTENANCE AND REPAIR | | | | | | | |
| 11.01 | Identified types and grades or brake fluid | | | | | | | |
| 11.02 | Checked brake master cylinder fluid and fill to proper levels | | | | | | | |
| 11.03 | Inspected brake lines for condition and leaks | | | | | | | |
| 11.04 | Inspected parking brake operation | | | | | | | |
| 11.05 | Adjusted service brakes (non-self adjusting) | | | | | | | |
| 11.06A | Adjusted hand brake linkage | | | | | | | |
| 11.06B | Adjusted external band | | | | | | | |
| 11.07 | Inspected brake pedal height and performed required adjustments | | | | | | | |
| 11.08 | Replaced hand brake linkage | | | | | | | |
| 11.09 | Bled hydraulic brakes (manual) | | | | | | | |
| 11.10 | Diagnosed brake system problems | | | | | | | |
| 11.11 | Serviced brake warning system | | | | | | | |
| 11.12 | Inspected and replaced brake metering valve | | | | | | | |
| 11.13 | Inspected, repaired, or replaced self-adjusters | | | | | | | |
| 11.14 | Replaced brake hoses and lines | | | | | | | |
| 11.15A | Inspected and replaced brake pads (disc brakes) | | | | | | | |
| 11.15B | Repaired disc brake calipers | | | | | | | |
| 11.16 | Inspected and replaced brake shoes | | | | | | | |
| 11.17 | Inspected and turned rotor on disc brakes | | | | | | | |
| 11.18 | Inspected and refinished brake drums | | | | | | | |
| 11.19 | Radius grinded brake shoes | | | | | | | |
| 11.20 | Inspected, repaired, or replaced wheel cylinder | | | | | | | |
| 11.21A | Removed or replaced master cylinder | | | | | | | |
| 11.21B | Repaired cylinder | | | | | | | |
| 11.22 | Repaired or replaced hydraulic power brake components | | | | | | | |
| 11.23 | Performed operational brake inspection | | | | | | | |
| UNIT 12.0 | AUTOMOTIVE SERVICING | | | | | | | |
| 12.0 | Serviced or repaired automobiles | | | | | | | |
| UNIT 13.0 | SERVICING DIESEL FUEL INJECTION SYSTEM | | | | | | | |
| 13.01 | Adjusted engine idle | | | | | | | |
| 13.02 | Bled fuel system | | | | | | | |
| 13.03 | Cleaned injector | | | | | | | |
| 13.04 | Replaced fuel injector | | | | | | | |
| 13.05 | Installed and timed fuel injection pump | | | | | | | |

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# APPENDIXES

| | |
|---|---|
| Appendix A | GTC Articulated Courses |
| Appendix B | Additional Automotive Mechanics Courses |
| Appendix C | Joint Articulation Agreement |
| Appendix D | Instructor's Signed Agreement to Articulate |
| Appendix E | Philosophy of Articulation Guide Design |
| Appendix F | Purposes of Articulation Guide |
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| Appendix J | Binder Design |

Appendix A 1

GREENVILLE TECHNICAL COLLEGE
Greenville, S.C.

## Course Syllabus
(Cover Sheet)

Course Number AUT 111

Course Title Power Plant Fundamentals

Lecture Hours Per Week 4 Lab Hours Per Week 3 Quarter Credit Hours 5 (Equivalent Semester Hours)

Prerequisite None

Catalog Course Description Student learns automotive fundamentals, principles of engine operations, including HP calculations, efficiency combustion theory, etc. Types of engines, cylinders, and valve arrangements, lubrications, fuel exhaust systems and cooling are also included.

General Course Goals Student will be able to demonstrate an understanding of the principles of internal combustion engines and the purpose and function of its systems and component parts. Reading of the text classroom discussions and lab exercises will be utilized.

Text(s) Automotive Mechanics, Crouse 7th edition

Rationale Modern auto technicians must effectively trouble shoot, service and repair all engine problems efficiently.

Prepared by Lyle K. Stelter

Approved by Weisner
Division Dean

Approved by
Vice President for Education

Date Written

Date Revised

Course First Offered

Course Deleted

| Text Chapter | Topics/Concepts | Week of Instruction | Mode of Instruction |
|---|---|---|---|
| 9 | Engine Fundamentals | 1 | Lecture, Filmstrip |
| 10 | Piston engine operation | 2 | Lecture, Demonstration |
| 11 | Engine Types<br>A. Cylinder arrangement<br>B. Valve system arrangement<br>C. Types of cooling -<br>D. Types of fuel | 2 | Filmstrips, Engine Dis-assembly |
| 12 | Engine Construction<br>A. Cylinder block<br>B. Cylinder heads<br>C. Crankshaft and bearing | 3 | " " |
| 13 | Engine construction<br>A. Pistons, rings and connecting rods | 4 | " " |
|  | Engine construction<br>A. Valves and value trains | 5 | " " |
| 15 | Rotary engines<br>Turbines and Wankels | 6 | " " |
| 16 | Engine measurement and performance | 7 | " " |
| 17,18,19 | Automotive Engine fuels<br>Automotive Fuel Systems<br>Automotive Carburetors | 8 | " " |
| 21,22 | Engine Lubricating Systems<br>Lubricating System Service | 9 | Lecture, Shop Demonstration |
| 23 | Engine Cooling Systems | 10 | " " |
| 24 | Cooling System Service<br>Engine Reassembly | 11 | Shop exercise<br>Final exam |

Exams - Mid Term/Final

The above sequence will be closely followed. Some deviation may occur due to unscheduled activities or project assignments.

GREENVILLE TECHNICAL COLLEGE
Greenville, South Carolina

| (How can it be taught-lecture, text, slides, etc?) INSTRUCTIONAL MODES | (What specific text(s), slides, lecture(s), etc. will you use?) INSTRUCTIONAL RESOURCES | (Can you give a test item example?) SAMPLE ASSESSMENT ITEM (OPTIONAL) |
|---|---|---|
| Textbook<br>Reading Assignment<br>Shop Demonstration<br>Filmstrip Study<br>Shop Exercise | Automotive Mechanics, Crouse 7th Edition<br>Filmstrip - Internal Comb. Eng. operation<br>Combustion Today's Engine | Quiz<br>Final Exam |

TESTING AND EVALUATION:

1. Chapter and quiz - all multiple choice (5), (All scores are averaged for one (1) score)
2. A final exam will cover all material studied.
3. Projects will be evaluated on performance and participation.

PERCENTAGE OF FINAL GRADE:

1. All quiz scores averaged for - 25% of final grade
2. Final exam score - 25% of final grade
3. Shop projects - performance/participation 50% of final grade

NOTE: Chapter or section quiz may be made up during quarter at instructor's convenience.

Final exam - no make up (exception: special circumstance)

2

Distribution Date ______

GREENVILLE TECHNICAL COLLEGE
Greenville, SC

Course Syllabus Cover Sheet

Course Number AUT 112

Course Title Fundamentals of Automotive Electricity

Lecture hours per week 3

Lab/Shop/Clinic hours per week 3

Quarter credit hours 4

(Equivalent semester hours ______

Prerequisite None

Catalog course description The study of the fundamentals of electricity and magnetism. This course familiarizes the student with basic circuits, batteries, cranking motors and ignition systems.

Purpose of the course To provide the student with a working knowledge of basic automotive electrical theory. To demonstrate fundamental service procedures, troubleshooting, and the operation of relevant test equipment.

Required text(s) or other materials Automotive Mechanics, William H. Crouse

Developed by D.L. Watson

Date May 25, 1981

Approved by ______
Academic Dean

Date ______

GREENVILLE TECHNICAL COLLEGE

PLAN OF INSTRUCTION

COURSE NUMBER: AUT 112

COURSE TITLE: FUNDAMENTALS OF AUTO ELECTRICITY

| REFERENCES TEXT CHAPTER<br>Automotive Mechanics | MAJOR TOPICS | WEEK OF INSTRUCTION | MODE OF INSTRUCTION |
|---|---|---|---|
| 25 | Atomic Structure and Electron Theory | 1 | Lecture |
| 25 | Ohm's Law and Series Circuits | 2 | Lecture |
| 25 | Voltage Drop and Parallel Circuits | 3 | Lecture |
| 26 & 27 | Lead-Acid Storage Batteries | 4 | Lecture/ Field Trip/ Lab |
| 25 | Electro-Magnetism | 5 | Lecture |
| 30 & 31 | D.C. Generators and Regulators | 6 | Lecture/Lab |
| 30 & 31 | Alternators and Alternator Regulators | 7 & 8 | Lecture/Lab |
| 28 & 29 | Starting Motors | 9 | Lecture/Lab |
| 32 | Standard Ignition Systems | 10 & 11 | Lecture/Lab |

**Sequence of topics is subject to change due to availability of lab projects.

## GREENVILLE TECHNICAL COLLEGE

COURSE TITLE: AUT 112 Fundamentals of Auto Electricity

CREDIT HOURS: Four

### TERMINAL OBJECTIVES

Students who successfully complete the above course will have demonstrated the skills required to accomplish the following objectives:

1. After study of the appropriate text chapter and completion of classroom assignments, the student will describe the construction of the atom and define electricity per the Electron Theory.

2. After study of the appropriate text chapter and classroom exercises, the student will calculate the resistance, amps or volts of a simple series circuit when given two known values.

3. After study of the appropriate text chapter and completion of classroom exercises, the student will be able to recognize a parallel circuit and calculate the voltage drops, amps and total resistance or voltage impressed when given the appropriate known values.

4. Upon completion of reading assignments, lectures and demonstrations, th student will define the three primary functions of an automotive batter Also, the student will name the active materials contained in and descri the construction of a single lead acid cell.

5. After study of the appropriate text chapter and lectures, the student will describe the construction of an electro-magnet and name the three things that can be done to change its strength.

6. After study of the appropriate text chapter and completion of classroom and lab assignments, the student will list and define the major parts of and describe how current flow is induced in a D.C. generator. Also, the student will identify and explain the function of each of the three elements of a D.C. generator regulator.

7. Upon completion of appropriate reading assignments, demonstrations and lab projects, the student will name and define the major components of an alternator charging system. Furthermore, the student will describe the function of a double-contact regulator including its three modes of operation.

8. After completing reading assignments and classroom lecture, the student will describe the operation of a typical, late model starter motor including the function of the solenoid.

9. The student, after reading the text chapter and completing classroom projects, will describe, in detail, the sequence of events that occur in one complete ignition cycle.

GREENVILLE TECHNICAL COLLEGE
Greenville, S.C.

Course Syllabus
(Cover Sheet)

Course Number AUT 128

Course Title Tools & Equipment, Use, Care & Maintenance

Lecture Hours Per Week 2

Lab Hours Per Week 3

Quarter Credit Hours 3

(Equivalent Semester Hours)

Prerequisite None

Catalog Course Description Students gain knowledge in the proper selection of tools and equipment, when to use, proper applications including maintenance and safety.

General Course Goals Student will understand the correct use of hand tools power tools and equipment required in repair and reconditioning of automotive components. Student will correctly operate equipment and understand maintenance and housekeeping requirements.

Text(s) Automotive Mechanics, Crouse 7th edition

Rationale Student must perform individual repairs and procedures in his daily work

Prepared by Lyle K. Stelter

Approved by
Division Dean

Approved by
Vice President for Education

Date Written

Date Revised

Course First Offered

Course Deleted

Course Syllabus
Page 2

| Text Chapter | Topics/Concepts | Week of Instruction | Mode of Instruction |
|---|---|---|---|
| ④ | Automotive Fasteners | 1 | Lecture &<br>Demonstratio |
| ⑤ | Hand Tools | 1-2 | Lecture, Sho<br>Demonstratio<br>Filmstrip |
| 6 | Cutting Tools<br>A. Drilling<br>B. Tapping (thread cutting)<br>C. Hand files & hack saws<br>D. Chisels<br>E. Tool and drill grinding and repair | 3-4 | Demonstratio<br>and shop<br>exercise<br>Filmstrip |
| | Repair Procedure - Special Tools<br>A. Removal of broken studs<br>B. Installation of Helicoils<br>C. Valve guide knurling<br>D. Valve and seat grinding | 5,6,7 | Filmstrip<br>Shop Demonstration &<br>exercise |
| 8 | Measuring Tools | 8 | Lecture,<br>Filmstrip,<br>Demonstration |
| | Service Procedures-Power Equipment<br>A. Brake drum and disc turning<br>B. Hydraulic press operation<br>(Bearing removal - replacement)<br>C. Engine cylinder boring | 9-11 | |

GREENVILLE TECHNICAL COLLEGE
Greenville, South Carolina

| (How can it be taught- lecture, text, slides, etc?) INSTRUCTIONAL MODES | (What specific text(s), slides, lecture(s), etc. will you use?) INSTRUCTIONAL RESOURCES | (Can you give a test item example?) SAMPLE ASSESSMENT ITEM (OPTIONAL) |
|---|---|---|
| lass Lecture and demonstra-<br>ion, Film strips | Text Reading assign.<br>Chapters:<br>-Filmstrips<br>Hand tool safety (snap-on)<br>"Removal of broken studs"<br>A-<br>"Valve Guide knurling"<br>(United tool process)<br>"Valve servicing" and assy.<br>SS-501 Hand Tool Safety - Snap-on<br>Bergwall Series: Shop Safety (5)<br>Hoffman:<br>2.1B Decimals - Millimeters & Conversion<br>2.1C Measurement<br>2.3A Tool Identification & Use<br>2.3B Fasteners Types & Uses<br>2.4A Procedure to Drill & Top | Student shop exercise<br>Remove broken studs<br>Drill & Top Hole<br>Drill-bit Grinding Procedure<br>Correct Procedure:<br>Hack-Sawing |

TESTING AND EVALUATION FOR GRADE:

All quiz scores will be averaged for (1) score——25%

Shop performance: Each project performance will be graded on spot. Grades will be averaged for——50%

Final Exam——25%

Written quiz paper may be made up during quarter at instructor's convenience.

No make-up on Final Exam.

Shop project performance may be repeated for improved grade.

Instructor

Distribution Date

# GREENVILLE TECHNICAL COLLEGE
Greenville, SC

## Course Syllabus Cover Sheet

Course Number AUT 123

Course Title Fuel Systems and Carburetion

Lecture hours per week 3

Lab/Shop/Clinic hours per week 6

Quarter credit hours 5

(Equivalent semester hours

Prerequisite None

Catalog course description A basic course of gasoline engine fuel system study. This includes principles of carburetion and components of the fuel system such as fuel pumps, system plumbing, manifolding and fuel injecting.

Purpose of the course To instruct the student in automotive fuel system theory and service procedures, including troubleshooting and unit repair.

Required text(s) or other materials Automotive Mechanics, William H. Crouse

Developed by D.L. Watson

Date May 26, 1981

Approved by
Academic Dean

Date

# GREENVILLE TECHNICAL COLLEGE

## PLAN OF INSTRUCTION

COURSE NUMBER: AUT 123

COURSE TITLE: FUEL SYSTEMS AND CARBURETION

| REFERENCES TEXT CHAPTER | MAJOR TOPICS | WEEK OF INSTRUCTION | MODE OF INSTRUCTION |
|---|---|---|---|
| Automotive Mechanics | | | |
| 17 | Properties of Gasoline and Octane Ratings | 1 | Lecture |
| 17 | Preignition vs. Detonation | 2 | Lecture/ Demonstration |
| 18 | Purpose of the Fuel System and Related Components | 3 | Lecture/Lab |
| 18 | Mechanical and Electric Fuel Pumps Theory and Diagnosis | 4 | Lecture/Lab |
| 18 | Causes and Prevention of Vapor Lock | 5 | Lecture/Lab |
| 18 | Air Cleaners and Manifold Systems | 6 | Lecture/Lab |
| 19 | Carburetor Fundamentals and Air Fuel Ratio Requirements | 7 | Lecture |
| 20 | Automotive Carburetors Diagnosis and Overhaul | 8 & 9 | Lab |
| 18 | Fuel Injection and Turbo-charging | 10 | Lecture/Lab |
| 20 | Automotive Fuel System Troubleshooting | 11 | Lab |

**Sequence of topics is subject to change due to availability of lab projects.

# GREENVILLE TECHNICAL COLLEGE

COURSE TITLE: AUT 123 Fuel Systems and Carburetion

CREDIT HOURS: Five

## TERMINAL OBJECTIVES

Students who successfully complete the above course will have demonstrated the skills required to accomplish the following objectives:

1. Upon completion of classroom and reading assignments, the student will compare and contrast the volatility blend of winter and summer grades of gasoline.

2. The student will, after reading assigned chapters and completing classroom exercises, define detonation and preignition, listing three causes for each condition.

3. After appropriate textbook study and instructor demonstration, the student will name and define all of the components of a standard automotive fuel system.

4. Upon completion of laboratory and reading assignments, the student will demonstrate the proper test procedure for diagnosis of an automotive fuel pump, using the necessary test equipment.

5. After appropriate lectures and demonstrations, the student will define vapor lock, list the causes of and identify the components involved in a vapor lock control system.

6. After instructor demonstration and lecture, the student will list the three purposes of an automotive air cleaner and draw a typical dual plane intake manifold for a two barrel carburetor, showing all distribution passages.

7. Upon completion of reading assignments and classroom exercises, the student will describe a simple carburetor and explain venture action.

8. Given a late model automotive carburetor and the necessary specifications, the student will identify the six fuel flow circuits used and overhaul the unit completely, making all necessary repairs and adjustments to manufacturer's specifications.

9. After completion of reading assignments and lectures, the student will describe a simple turbo-charging system including all basic components. The student will also compare and contrast a carburetor system with fuel injection.

10. Given the proper test equipment and a malfunctioning fuel system on a late model vehicle, the student will diagnose the problem and make necessary repairs and adjustments needed to return the vehicle to performance specifications.

## AUTO BODY REPAIR

The field of auto body repair and painting requires a large number of well-trained people to meet the growing demand for many skills needed in this area of employment. People with a background of knowledge and skills in this field have excellent opportunities for jobs with good salaries. Many of these craftsmen, after gaining additional experience, go on to open their own businesses or become body shop foremen, supervisors or managers.

The Auto Body Repair Program is a four quarter diploma program offering training in the technical and manual skills involved in the realignment, repair, and refinishing of motor vehicles.

### First Quarter

| | |
|---|---|
| MAT 167 | Applied Math - Automotive |
| ABR 101 | Tools and Equipment |
| ABR 111 | Structural Repair I |
| ABR 141 | Auto Sheetmetal & Frame Gas Welding |

### Second Quarter

| | |
|---|---|
| ABR 112 | Auto Sheet Metal Repair I |
| ABR 121 | Structural Repair II |
| ABR 146 | Shop Management |
| ECO 100 | Consumer Economics |

### Third Quarter

| | |
|---|---|
| ABR 116 | Refinishing I |
| ABR 122 | Auto Sheet Metal Repair II |
| ABR 134 | Trim and Glass |
| PSY 112 | Industrial Human Relations |

### Fourth Quarter

| | |
|---|---|
| ABR 123 | Estimating Repairs |
| ABR 132 | Auto Sheet Metal Repair III |
| ABR 126 | Refinishing II |
| ABR 118 | Processes and Products |
| ENG 151 | Language Applications |

## AUTOMOTIVE MECHANIC

Automotive Technology is becoming increasingly complex. Emission controls and safety systems, air conditioning systems, and complex electrical, vacuum and hydraulic accessories are just some of the many changes tomorrow's technician must cope with. The only way to accomplish this is to be thoroughly trained in theory, in diagnostic techniques, and in a wide variety of automotive servicing skills.

The Automotive Mechanic Program is a four quarter diploma program offering training in the technical and manual skills involved in the testing, diagnosis, and servicing of motor vehicles.

### First Quarter

| | |
|---|---|
| MAT 167 | Applied Math - Automotive |
| AUT 111 | Power Plant Fundamentals |
| AUT 112 | Fundamentals of Automotive Electricity |
| AUT 128 | Tools & Equipment, Use, Care and Maintenance |
| WLD 125 | Automotive Welding |

### Second Quarter

| | |
|---|---|
| ENG 151 | Language Applications |
| PHY 111 | Applied Physics |
| AUT 123 | Fuel Systems and Carburetion |
| AUT 124 | Electrical Systems I |

### Third Quarter

| | |
|---|---|
| PSY 112 | Industrial Human Relations |
| AUT 121 | Internal Combustion and Engine Reconditioning |
| AUT 133 | Power Train I |
| AUT 109 | Automatic Transmission Systems |

### Fourth Quarter

| | |
|---|---|
| AUT 132 | Brakes I |
| AUT 142 | Steering & Suspension Systems I |
| AUT 143 | Automotive Accessories |
| AUT 131 | Automotive Diagnosis & Repair I |
| ECO 100 | Consumer Economics |

## DIESEL HEAVY EQUIPMENT MECHANIC

This course is designed to prepare the student for employment as a heavy equipment mechanic. Many job opportunities will be available because of the expanding use of heavy equipment in the national road building program and other types of construction. As more and more heavy equipment (such as tractor-trailer trucks, cranes, earth movers, tractors, etc.) is brought into use, more and more mechanics will be needed to maintain it.

The student will receive instruction and practice in all phases of work expected of a heavy equipment mechanic and the proper use of all tools involved. A diploma will be awarded upon the completion of the curriculum.

### First Quarter

| | |
|---|---|
| WLD 125 | Automotive Welding |
| MAT 167 | Applied Math |
| DHM 111 | Internal Combustion Engines I |
| AUT 112 | Fundamentals of Automotive Electricity |
| AUT 128 | Tools and Equipment, Use, Care and Maintenance |

### Second Quarter

| | |
|---|---|
| DHM 124 | Electrical Systems for Heavy Equipment |
| ENG 151 | Language Applications |
| DHM 121 | Internal Combustion Engines II |
| DHM 123 | Fuel Injection System |

### Third Quarter

| | |
|---|---|
| PSY 112 | Industrial Human Relations |
| DHM 122 | Hydraulic Systems |
| DHM 131 | Power Trains |
| DHM 141 | Power Shift Transmission and Torque Converters |

### Fourth Quarter

| | |
|---|---|
| PHY 111 | Applied Physics |
| DHM 142 | Steering, Clutches, Brake System and Track System |
| DHM 125 | Accessories |
| DHM 144 | Truck Servicing and Troubleshooting |
| ECO 100 | Consumer Economics |

5

Distribution Date ____________

GREENVILLE TECHNICAL COLLEGE
Greenville, SC

Course Syllabus Cover Sheet

Course Number AUT 124

Course Title Electrical Systems I

Lecture hours per week 4

Lab/Shop/Clinic hours per week 1

Quarter credit hours 6

(Equivalent semester hours ____

Prerequisite AUT 112 Fundamentals of Automotive Electricity

Catalog course description An advanced study is made of electrical systems, components, and operation. Included in this study are printed circuits, alternators and generators, various types of wiring including those used on commercial vehicles. All components are checked with modern testing and diagnostic equipment. The student will demonstrate his mastery of the subject by troubleshooting electrical systems and repairing based on his findings.

Purpose of the course To provide the student with the knowledge necessary to diagnose and repair any type of vehicle electrical system malfunction.

Required text(s) or other materials Automotive Mechanics, William H. Crouse

Developed by D.L. Watson

Date May 25, 1981

Approved by ____________
Academic Dean

Date ____________

GREENVILLE TECHNICAL COLLEGE
PLAN OF INSTRUCTION
COURSE NUMBER: AUT 124
COURSE TITLE: ELECTRICAL SYSTEMS I

| REFERENCES TEXT CHAPTER | MAJOR TOPICS | WEEK OF INSTRUCTION | MODE OF INSTRUCTION |
|---|---|---|---|
| Automotive Mechanics | | | |
| 32-33 | Electronic Ignition Systems Theory and Diagnosis | 1 | Lecture/Lab |
| 33-42 | Ignition Oscilloscope Testing | 2 | Demonstratio<br>Lab |
| 44 | Ignitions System Tune-Up | 3 | Lecture/Lab |
| 29 | Starting System Diagnosis and Repair | 4 | Lecture/Lab |
| 27 | Lead-Acid Batteries Diagnosis and Servicing | 5 | Lab |
| 31 | Charging Systems Diagnosis and Repair | 6 | Lecture/Lab |
| 31 | Interpretation of Alternator Oscilloscope Waveforms | 7 | Lab |
| 31 | Charging System Regulators Diagnosis and Adjustment | 8 | Lecture/Lab |
| 34 | Interpretation of Wiring Schematics | 9 | Lecture/<br>Demonstratio |
| 34 | Electrical Accessories and Wiring Diagnosis and Repair | 10-11 | Lecture/Lab |

**Sequence of topics is subject to change according to class progress and availability of lab projects.

## GREENVILLE TECHNICAL COLLEGE

**COURSE TITLE:** AUT 124 Electrical Systems I

**CREDIT HOURS:** Four

## TERMINAL OBJECTIVES

Students who successfully complete the above course will have demonstrated the skills required to accomplish the following objectives:

1. Upon completion of reading assignments and lab projects, the student will, using appropriate test equipment, troubleshoot, repair, and make all necessary adjustments to a malfunctioning electronic ignition system on a late model vehicle.

2. After careful study of appropriate reading assignments and instructor demonstrations, the student will correctly connect an oscilloscope to a vehicle, perform the required test sequence, evaluate test results, and make necessary repair recommendations.

3. Given appropriate test equipment and a late model vehicle, the student will perform a complete engine tune-up, making all necessary repairs and adjustments to the manufacturer's specifications.

4. Given a malfunctioning automotive starter and the proper test equipment, the student will diagnose and repair the defective unit according to manufacturer's specifications.

5. Using the required test equipment on a discharged automotive battery, the student will determine if the battery is good, chargeable, or defective in ten minutes time.

6. On a late model vehicle, the student will properly connect the necessary test equipment, test the charging system and make all repairs needed to return the system to performance specifications.

7. The student will correctly connect an oscilloscope to an alternator charging system, interpret the waveform and list the problems indicated, after instructor demonstrations.

8. Upon completion of required reading assignments and lab projects, the student will correctly diagnose and repair or adjust as needed, a double-contact voltage regulator to manufacturer's specifications.

9. Given a late model automotive wiring schematic, the student will trace a typical accessory circuit, identifying all electrical symbols indicated, after completion of required reading assignments and lectures

10. The student will, after instructor demonstration, diagnose and repair a defective electrical accessory circuit, using the proper schematic and necessary test equipment.

Instructor ____________________

Distribution Date ____________________

**GREENVILLE TECHNICAL COLLEGE**
**Greenville, SC**

**Course Syllabus Cover Sheet**

Course Number AUT 121

Course Title Internal Combustion Engine Reconditioning

Lecture hours per week 4 Lab/Shop/Clinic hours per week 12 Quarter credit hours 8 (Equivalent semester hours ____

Prerequisite None

Catalog course description The step process of engine overhaul is accomplished through class discussion and shop demonstrations with student participation. Students are required to perform in all phases of "rebuild": cleaning specifications, pertinent measurement, assembly and "run" of unit. "Live" engines are utilized and made operational.

Purpose of the course For the student to correctly demonstrate the ability to recondition an internal combustion engine, cleaning, measuring, machining of all components, adjusting all specifications and completing assembly. Engine will "run" satisfactorily. Classroom discussions and lab instruction will be utilized.

Required text(s) or other materials Automotive Mechanics, Crouse 7th Edition

Developed by Lyle Stelter Date June 2, 1981

Approved by ____________________ Date ____________________
Academic Dean

GREENVILLE TECHNICAL COLLEGE

COURSE TITLE: AUT 121 Internal Combustion Engine Recondition

CREDIT HOURS: Eight

## TERMINAL OBJECTIVES

Students who successfully complete the above course will have demonstrated the skills required to accomplish the following objectives:

1. Given appropriate engine components and following lab demonstrations, student will disassemble valve-train systems and properly clean to instructor's satisfaction.
2. Using components as assigned and after lab demonstrations, student will be able to recondition cylinder head valve guides to factory specifications.
3. Using engine cylinder heads and appropriate grinding equipment, student will recondition valve faces and seats to factory specifications.
4. With appropriate manuals of specification and following instructor demonstrations, student shall measure, adjust to specification and assemble cylinder head valve systems.
5. After specific instruction and lab demonstrations, student shall disassemble rod and piston unit and inspect for serviceability.
6. After lab demonstrations, using factory specifications, student will be able to refit piston pins and specify piston re-sizing for a given engine.
7. After instructor's lab demonstrations, student shall fit, adjust, and measure gaps on piston rings and install according to manufacturer's specifications.
8. After specific equipment demonstration and lab instruction, using factory manuals, student will be able to recondition engine connecting rods to factory specifications.
9. Upon completion of textbook assignments, instructor lecture, and lab presentations, student will be able to determine serviceability of connecting rod bearings and replace as necessary.
10. Upon completion of study assignments, instructor lectures, and lab exercises, student shall determine serviceability of crankshaft main bearings and replace as necessary.

GREENVILLE TECHNICAL COLLEGE
Greenville, S.C.

## Course Syllabus
## (Cover Sheet)

**Course Number** AUT 133

**Course Title** Power Train I

**Lecture Hours Per Week** 2 **Lab Hours Per Week** 6 **Quarter Credit Hours** 4 **(Equivalent Semester Hours)**

**Prerequisite** None

**Catalog Course Description** A study of clutches, conventional automotive transmissions and overdrives. Included are drive line with universal joints, differentials and rear axles. The student will demonstrate his ability to rebuild each of these units.

**General Course Goals** The student will know the principles of operation of clutches, transmissions (conventional), drive shafts, and final drives (or rear axles) to the extent that the knowledge should be applicable by the student to the servicing of these units as necessary.

**Text(s)** Automotive Mechanics, 7th edition, Crouse, Mfgrs' Service Manuals

**Rationale** Based on vehicle design and ownership patterns, even if there is innovation by 1985, our graduates must be capable of servicing these units through 1991 - 1995 or later.

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**Prepared by** W.M. Loukides

**Approved by** ______
Division Dean

**Approved by** ______
Vice President for Education

**Date Written** August 1980

**Date Revised** ______

**Course First Offered** August 1980

**Course Deleted** ______

GREENVILLE TECHNICAL COLLEGE
PLAN OF INSTRUCTION
COURSE NUMBER: AUT 133
COURSE TITLE: POWER TRAIN I

| REFERENCES TEXT CHAPTER | MAJOR TOPICS | WEEK OF INSTRUCTION | MODE OF INSTRUCTION |
|---|---|---|---|
| 51 | Propeller Shaft - its purpose, designs and construction (single and multiple shafts) | 1 | Lecture, Demo Parts |
| 51 | Universal joints - theory, construction and service needs | 1 | Lecture, Demo Parts |
| 51<br>MFG Manuals | Drive line inspection, service and or repair | 2 | Live Units in Lab |
| 45 | Clutch - its purpose, designs, constructions and service needs | 3 | Lecture, Demo Parts |
| 46<br>MFG Manuals | Clutch inspection, service and or repair | 4 | Live Units in Lab |
| 47 | The manual transmission - its purpose designs, constructions and service needs | 5 | Lecture, Cut away Units, Demo Parts |
| 48<br>MFG Manuals | Manual Transmission inspection, service and or repair | 6-7 | Live Units in Lab |
| 52 | The rear axle and differential - its purpose, designs, constructions, and service needs | 8 | Lecture, Demo Parts |
| MFG Manuals | Rear axle and differential inspection, service, and or repair | 9-10 | Live Units in Lab |
| MFG Manuals | Completion, final closure, and or review of projects and instruction undertaken in the study of the power train (minus engine) | 11 | Live Units in Lab |

## GREENVILLE TECHNICAL COLLEGE

COURSE TITLE: AUT 133 Power Train I

CREDIT HOURS: Four

### TERMINAL OBJECTIVES

Students who successfully complete the above course will have demonstrated the skills required to accomplish the following objectives:

1. Given a vehicle with drive shaft in place, the student will inspect the drive shaft assembly and classify it as serviceable or unserviceable with respect to its phasing and universal joint condition. In the event the shaft is serviceable, the student will state the phasing and joint conditions that would have called for the shaft assembly to be classified as unserviceable.

2. Given a vehicle with a defective drive shaft assembly, the student will remove and repair the drive shaft as necessary except for possible machine shop operations which may be subject for specialized service. The student will have correctly cared for the shaft assembly while it was being serviced and will have correctly lubricated it where necessary prior to the road test.

3. Given a vehicle with a questionably working clutch, the student will determine whether or not the clutch is of the semi-centrifugal type and then adjust the clutch pedal clearance as required by the clutch. NOTE: If the pedal clearance is initially found to be correct, the student will describe the indications that would have required a correction of the pedal clearance.

4. Given a vehicle with a slipping clutch, the student will analyze the clutch system and be able to perform the steps to be taken to correct this defect of the vehicle.

5. Given a vehicle which has unusual sounds coming from in or about the clutch, the student will after inspecting the vehicle be able to determine that the origin of the sound(s) is the 1) pilot bearing, 2) throw-out bearing, and/or 3) transmission. NOTE: It is not common for all of these sounds to appear at the same time in one vehicle. This being the case, the student will identify what sound(s) are heard relative to this objective and be able to describe the procedures to identify those sounds which are not heard at this time.

6. Given sectional views (drawings or photos) of Saginaw and Borg Warner types of three-speed and Warner or Muncie four-speed transmissions shown in each of their gearing positions or speeds, the student will correctly trace the power flow through each of the given sectional views. NOTE: The above is an exam procedure - the student should, for purposes of study, discussion, etc. be able to perform the same through the use of live and/or cutaway transmissions of the types listed above.

7. Given a vehicle with a malfunctioning gear shift system, the student will be able to determine the cause(s) of the malfunction, repair and/or replace any defective parts as necessary, and adjust the system to operate (or be operable) as the vehicle manufacturer's designers intended.

8. Given a transmission (in vehicle or out) (manual or automatic) with a faulty extension housing bushing, the student will replace the bushing, complete without removing the extension housing from the transmission. NOTE: This operation will be applicable only to those transmissions for which the necessary special tools are available.

9. Given a differential assembly, the student will be able to produce a tooth contact pattern and then, based on the appearance of the pattern, determine what gear adjustments are necessary for acceptable performance of the gears per their design limits. Prerequisite to this objective is the students ability to recognize an ideal pattern and deviations from the ideal.

10. Given the terms "backlash" and "preload as applied to the differential assembly, the student will define each term.

11. Given a serviceable full floating rear axle assembly, the student will demonstrate the removal and replacement of one of the axle shafts through performance of the operation.

12. Given a semi-floating rear axle assembly with bearing pressed on shaft, the student will perform the complete operation of bearing replacement from the removal of the axle to its replacement.

13. Given a semi-floating rear axle assembly with bearing pressed in housing tube, the student will perform the complete operation of bearing replacement from the removal of the differential cover to and including the lubrication of the differential.

Instructor ______

Distribution Date ______

GREENVILLE TECHNICAL COLLEGE
Greenville, SC

Course Syllabus Cover Sheet

Course Number AUT 109

Course Title Automatic Transmission Systems

Lecture hours per week 2

Lab/Shop/Clinic hours per week 3

Quarter credit hours 3

(Equivalent semester hours ______

Prerequisite None

Catalog course description A basic study of automatic (hydraulic) transmissions by an individual study of fluid couplings, torque converters, principles of automatic controls and planetary gear systems with maintenance and repair service included.

Purpose of the course To teach the student the fundamentals of automatic transmission construction and operation to the extent that these fundamentals should be applicable by the student to the diagnosis and repair of automatic transmissions.

Required text(s) or other materials Automotive Mechanics, William Crouse

Developed by William Loukides

Date May 27, 1981

Approved by
Academic Dean

Date 6/5/81

## GREENVILLE TECHNICAL COLLEGE

COURSE TITLE: AUT 109 Automatic Transmission Systems

CREDIT HOURS: Three

### TERMINAL OBJECTIVES

Students who successfully complete the above course will have demonstrated the skills required to accomplish the following objectives:

1. Given five different samples of automatic transmission fluid (each on its own service dip-stick), the student will, subject to further testing as necessary, be able to make a preliminary diagnosis of the condition of each of the subject transmissions by relating the conditions of the fluids and dip-sticks to conditions within the transmissions.

2. Given a "serviceable" transmission and torque converter as separate units, the student will correctly assemble the converter with its transmission.

3. Given an automatic transmission off engine, the student will attach the unit to the engine completely and correctly in the first attempt during which bolts and nuts are being applied to complete the attachment. NOTE: The only function of the nuts and bolts is to secure the fully mated units together. Any other nut or bolt applied force may destroy engine and/or transmission.

4. Given the three elements of a planetary gear set, the student will manipulate them so that the set will convert the student's inputs to outputs of (1) reduction, (2) direct, (3) overdrive, and (4) reverse at the students' demand.

5. Given an automatic transmission oil pump, the student will dismantle it, inspect it, identify any defects and correctly reassemble it.

6. Given an oil delivery sleeve with total sealing (interlocking) metal seals, the student will demonstrate the correct technique to unlock, remove, replace, and lock the seals in their correct positions — the seals must survive their installation without fracture or distortion.

7. Given a complete but disassembled clutch drum component, the student will be able to completely and correctly assemble the parts to form a unit which can be air tested to prove that it is serviceable.

8. Given stages in the assembly of a transmission at which thrust bearings or thrust washers are and are not required, the student will point out the sites which require the installation of thrust bearings or washers and those sites which require that the bearings or washers be omitted. NOTE: The student may be actually performing the assembly while pointing out the sites.

9. Given a servo, the student will disassemble it, inspect for and replace any defective parts, reassemble and test it to prove it is serviceable.

10. Given a sprag or overrunning clutch, the student will disassemble it, inspect for and replace any defective parts, reassemble and test it to be certain that it will rotate or lock when torqued in the correct directions.

11. Given a governor, the student will be able to recognize it for what it is and be able also to describe its reactions to the hydraulic and centrifugal forces which are imposed on it.

12. Given vehicles with and without modulator problems, the student will analyze each and identify the modulator(s) in need of services such as adjust, repair, and/or replace. NOTE: This process would eliminate those which are serviceable and need no further attention.

GREENVILLE TECHNICAL COLLEGE

PLAN OF INSTRUCTION

COURSE NUMBER: AUT 109

COURSE TITLE: AUTOMATIC TRANSMISSION SYSTEMS

| REFERENCES TEXT CHAPTER | MAJOR TOPICS | WEEK OF INSTRUCTION | MODE OF INSTRUCTION |
|---|---|---|---|
| Automotive Mechanics | | | |
| Film: Hydraulics Fundamentals (Chrysler Co.) | Fundamental hydraulic principles and theory | 1 | Lecture/Film |
| Bulletins: Quaker State ATF T-2000 | Transmission fluids - theory, inspections, and service | 1 | Lecture/ Bulletins |
| Chap. 49 | Fluid coupling - theory, inspections, and service | 2 | Lecture/Parts Demonstration |
| Chap. 49 | Torque converter - theory, inspections, and service | 2 | Lecture/Parts Demonstration |
| Instructor, No Text | Oil pumps - theory, inspections, and service | 2 | Lecture/Parts Demonstration |
| Chap. 49 | Planetary gears - theory, inspections and service | 3 | Lecture/Parts Demonstration |
| Chap. 49 | Clutches - construction, operation, inspection and service | 3 | Lecture/Parts Demonstration |
| Chap. 49 | Bands and servos - construction, operations, inspection and service | 3 | Lecture/Parts Demonstration |
| Instructor, No Text | Accumulators - theory, inspection and service | 4 | Lecture/Parts Demonstration |
| Chap. 49 | Sprag and overrunning clutches - theory inspection and service | 4 | Lecture/Parts Demonstration |
| Instructor, No Text | Transmission controls - driver operated-automatic | 4 | Lecture/Parts Demonstration |
| Torqueflite color book (Chrysler Co.) | Valve body, governor, modulator - theory inspection, and service | 5 | Lecture/Color Book, Slides |

PLAN OF INSTRUCTION
AMT 100 Automatic Transmission Systems
Page Two

| REFERENCES<br>TEXT CHAPTER | MAJOR TOPICS | WEEK OF INSTRUCTION | MODE OF INSTRUCTION |
|---|---|---|---|
| Torqueflite color book (Chrysler Co.) | Diagnosis/troubleshooting - theory and inspections | 5 | Lecture/Color Book, Slides |
| Chap. 50 & MFG Manuals | Service applications of the above instruction via servicing live units which are in need of repair/service | 6 - 11 | Laboratory Servicing of Defective Units - Live |

**Sequence of topics is subject to change due to availability of lab projects.

Distribution Date ______

GREENVILLE TECHNICAL COLLEGE
Greenville, SC

## Course Syllabus Cover Sheet

Course Number AUT 132

Course Title Brakes I

Lecture hours per week 5

Lab/Shop/Clinic hours per week 3

Quarter credit hours 6

(Equivalent semester hours ______

Prerequisite None

Catalog course description A study of the fundamental hydraulic laws and their application to automotive brake systems. Students will be performing periodic preventative maintenance, rebuilding hydraulic systems, replacing brake shoes and servicing the disc brake systems.

Purpose of the course To provide the student with the necessary technical knowledge theory and required skills to do a complete brake job. Complete job would meet manufacturer's specifications.

Required text(s) or other materials Automotive Mechanics, William H. Crouse

Developed by Glenn Hines

Date May 26, 1981

Approved by ______
Academic Dean

Date ______

# GREENVILLE TECHNICAL COLLEGE

## PLAN OF INSTRUCTION

COURSE NUMBER: AUT 132

COURSE TITLE: BRAKES I

| REFERENCES TEXT CHAPTER | MAJOR TOPICS | WEEK OF INSTRUCTION | MODE OF INSTRUCTIO |
|---|---|---|---|
| Automotive Mechanics | | | |
| 56 | Brakes - Hydraulic - | 1 | Textbook |
| 56 | Rebuilding Wheel Cylinder A | 2 | Lecture,<br>Slide & Fil |
| 56 | Rebuilding Master Cylinder A | 3 | Demonstrati<br>Live Project |
| 56 & 57 | Turning or Replacing Brake Drums | 4 | Demonstrati<br>Live Projec |
| 56 & 57 | Turning or Replacing Disc Brake Rotors | 5 | Demonstrati<br>Live Projec |
| 56 & 57 | Arc Grinding Brake Shoes | 6 | Demonstrati<br>Live Projec |
| 56 & 57 | Rebuilding Disc Brake Calibers | 7 | Demonstrati<br>Live Projec |
| 56 & 57 | Study of Related Parts, Equilizer Valves, Warning Devices | 8 | Demonstra<br>Live Projec |
| 56 | Power Brake Units | 9 | Demonstrati<br>Live Projec |
| 56 & 57 | Rebuild Drum Brakes | 10 | Demonstrati<br>Live Projec |
| 56 & 57 | Rebuild Disc Brakes | 11 | Demonstratic<br>Live Projec |

The above sequence will be closely followed. Some deviation may occur due to unscheduled activities or assignments.

GREENVILLE TECHNICAL COLLEGE

COURSE TITLE: AUT 132 Brakes I

CREDIT HOURS: Six

## TERMINAL OBJECTIVES

Students who successfully complete the above course will have demonstrated the skills required to accomplish the following objectives:

1. After appropriate classroom study, the student will name and describe how each part of the hydraulic brake works.
2. Given an automotive wheel cylinder, the student will disassemble, hone, inspect, and reassemble to manufacturer's specifications.
3. Given a defective master cylinder, the student will disassemble, hone, inspect, and reassemble to manufacturer's specifications.
4. After necessary textbook study and instructor demonstration, the student will inspect and machine a brake drum within the manufacturer's tolerances.
5. Given a late model vehicle with a defective brake rotor, the student will inspect and recondition the unit as necessary using the appropriate equipment.
6. Given a set of brake shoes, the student will arc grind the shoes to match a reconditioned brake drum.
7. Given a disc brake caliper, the student will disassemble, inspect, hone, and reassemble it.
8. The student will name and describe the purpose of equilizer valves and warning devices.
9. Given a power brake unit, the student will disassemble, inspect, and repair the unit to manufacturer's specifications.
10. Given a vehicle with drum brakes, the student will overhaul the brake system repairing and/or replacing all parts as indicated.
11. Given a disc brake vehicle, the student will troubleshoot the brake system and replace and/or repair all defective parts as necessary.

10

Distribution Date ____________________

GREENVILLE TECHNICAL COLLEGE
Greenville, SC

Course Syllabus Cover Sheet

Course Number AUT 142

Course Title Steering & Suspension Systems I

Lecture hours per week 2 | Lab/Shop/Clinic hours per week 6 | Quarter credit hours 4 | (Equivalent semester hours ______

Prerequisite None

Catalog course description A technical and practical study of the principles of automobile and truck suspension systems, including steering, alignment and wheel balancing. The student becomes familiar with the use and application of balancing and alignment equipment.

Purpose of the course To provide the student with the necessary technical knowledge, theory, and required skills to perform front end repair. To align front ends, balance wheels on and off car.

Required text(s) or other materials Automotive Mechanics, William H. Crouse

Developed by Glenn Hines | Date May 26, 1981

Approved by ____________________ | Date ____________________
Academic Dean

# GREENVILLE TECHNICAL COLLEGE

## PLAN OF INSTRUCTION

COURSE NUMBER: AUT 142

COURSE TITLE: STEERING & SUSPENSION SYSTEMS I

| REFERENCES UNIT CHAPTER<br>Automotive Mechanics | MAJOR TOPICS | WEEK OF INSTRUCTION | MODE OF INSTRUCTION |
|---|---|---|---|
| 54 | Steering Geometry | 1 | Textbook |
| 53 - 59 | Pre-alignment Checks | 2 | Lecture |
| 53 - 59 | Replacing of Steering Parts | 3 | Slide & Fil |
| 53 - 59 | How to Use Hunter Alignment Equipment | 4 | Demonstratio |
| 53 - 59 | On Car Speed Balancing | 5 | Demonstrati |
| 53 - 59 | Off Car Speed Balancing | 6 | Demonstrati |
| 54 | Automotive Power Steering | 7 | Demonstrati |
| 53 | Replacement of Coil and Leaf Springs | 8 | Demonstrati |
| 53 | Replacement and Repair of McPherson Straits | 9 | Demonstrati |
| 54 | Repair of Power Steering | 10 | Demonstrati |
| 54 | Alignment of Several Makes and Model Passenger Cars | 11 | Demonstrati |

*Sequence of topics is subject to change due to availability of lab pro

## GREENVILLE TECHNICAL COLLEGE

COURSE TITLE: AUT 142 Steering & Suspension Systems I

CREDIT HOURS: Four

## TERMINAL OBJECTIVES

Students who successfully complete the above course will have demonstrated the skills required to accomplish the following objectives:

1. Upon completion of the textbook and classroom assignment, the student will name the five steering angles and describe what they do.
2. After instructor demonstration and classroom study, the student will list the pre-alignment checks as required by the equipment manufacturer.
3. Given a late model vehicle, the student will replace all defective parts as required by the instructor.
4. After instructor demonstration, the student will demonstrate how to use Hunter alignment equipment.
5. Given a vehicle and the necessary speed balancing equipment, the student will balance four wheels.
6. Using the required static balancing equipment, the student will balance one standard size wheel.
7. Given a power steering sector, the student will disassemble, inspect, and reassemble it.
8. Given a vehicle, the student will remove and replace the assigned spring using instructor demonstration procedures.
9. Given a vehicle, the student will remove the strut, replace and or repair the shock, and reinstall in the vehicle.
10. After appropriate textbook study and instructor demonstration, the student will adjust the front end of a late model vehicle to manufacturer's specifications.
11. Given a vehicle with a power steering problem, the student will diagnose it and repair as necessary.

Distribution Date ____________

GREENVILLE TECHNICAL COLLEGE
Greenville, SC

## Course Syllabus Cover Sheet

Course Number AUT 131

Course Title Automotive Diagnosis and Repair I

Lecture hours per week 3

Lab/Shop/Clinic hours per week 3

Quarter credit hours 4
(Equivalent semester hours ____

Prerequisite None

Catalog course description A practical study by correlating previous instructions, diagnosing to determine cause of a specific problem, performing preventative maintenance and repair services. The student will become proficient in performing these services and in the use of diagnostic and repair equipment.

Purpose of the course To further develop the students knowledge and skill in understanding a problem and its causes. To be able to diagnose and repair problems to meet manufacturer's specifications.

Required text(s) or other materials Automotive Mechanics, William H. Crouse

Developed by Glenn Hines

Date May 26, 19[illegible]

Approved by ____________
Academic Dean

Date ____________

GREENVILLE TECHNICAL COLLEGE
PLAN OF INSTRUCTION
COURSE NUMBER: AUT 131
COURSE TITLE: AUTOMOTIVE DIAGNOSIS AND REPAIR I

| REFERENCES TEXT CHAPTER | MAJOR TOPICS | WEEK OF INSTRUCTION | MODE OF INSTRUCTIO |
|---|---|---|---|
| Automotive Mechanics | | | |
| 9 - 16 | Automotive Engines Mechanical Diagnosis | 1 | Textbook, Lecture, Slide/Film Demonstrat |
| 17 - 24 | Fuel Systems | 2 | " " " " |
| 25 - 34 | Troubleshooting Automotive Electrical Equipment | 3 | " " " " |
| 35 - 37 | Troubleshooting Emission Control Systems | 4 | " " " " |
| 38 - 41 | Automotive Engine Preventive Maintenance | 5 | " " " " |
| 42 - 44 | Engine Tune Up Diagnosis | 7 - 6 | " " " " |
| 45 - 52 | Troubleshooting Automotive Power Trains | 9 | " " " " |
| 53 - 59 | Automotive Chassis Diagnosis | 10 | " " " " |
| 60 - 61 | Diagnosis and Repair of Automotive Safety Devices | 11 | " " " |

**The above sequence will be closely followed. Some deviation may occur du to unscheduled activities or assignments.

# GREENVILLE TECHNICAL COLLEGE

COURSE TITLE: AUT 131 Automotive Diagnosis and Repair I

CREDIT HOURS: Four

## TERMINAL OBJECTIVES

Students who successfully complete the above course will have demonstrated the skills required to accomplish the following objectives:

1. Given an engine with a typical mechanical failure and the necessary test equipment, the student will diagnose and repair as required.
2. On a late model vehicle with a fuel system malfunction, the student will diagnose the problem and repair as indicated.
3. Given an automotive electrical problem, the student will troubleshoot and repair as needed.
4. Given a faulty emission control system, the student will troubleshoot and repair to meet manufacturer's specifications.
5. The student will list and demonstrate preventive maintenance procedures on a typical automotive engine.
6. Given a late model vehicle with a misfiring engine, the student will diagnose and tune engine to meet manufacturer's specifications.
7. The student will diagnose a given automotive chassis problem and repair to manufacturer's specifications.
8. Given an automotive safety device problem, the student will diagnose and repair as needed.

11

Distribution Date ____________

GREENVILLE TECHNICAL COLLEGE
Greenville, SC

Course Syllabus Cover Sheet

Course Number AUT 143

Course Title Automotive Accessories

Lecture hours per week 2

Lab/Shop/Clinic hours per week 3

Quarter credit hours 3

(Equivalent semester hours ____

Prerequisite None

Catalog course description This study includes short sessions on the various types of automotive accessories designed for safety and comfort. Students will troubleshoot and/or make repairs and adjustments on automotive accessories.

Purpose of the course To provide the student with the necessary technical knowledge theory and required skills to service, adjust, and repair air condition.

Required text(s) or other materials Automotive Mechanics, William H. Crouse

Developed by Glenn Hines

Date May 26, 1981

Approved by ____________
Academic Dean

Date ____________

GREENVILLE TECHNICAL COLLEGE

PLAN OF INSTRUCTION

COURSE NUMBER: AUT 143

COURSE TITLE: AUTOMOTIVE ACCESSORIES

| REFERENCES TEXT CHAPTER | MAJOR TOPICS | WEEK OF INSTRUCTION | MODE OF INSTRUCTIO |
|---|---|---|---|
| Automotive Mechanics | | | |
| 59 | Principles of Air Condition | 1 | Textbook |
| 59 | System Controls | 2 | Lecture |
| 59 | Service Air Condition | 3 | Slide & Fil |
| 59 | System Diagnosis | 4 | Demonstrat |
| 59 | Component Replacement | 5 | Live Projec |
| 59 | Compressor Service | 6 | Live Projec |
| 59 | Use of Service and Repair Equipment | 7 - 8 | Live Projec |
| 34 | Repair of Power Window and Seats | 9 - 10 | Live Projec |
| 34 | Repair of Cruise Control | 11 | Live Projec |

**Sequence of topics is subject to change due to availability of lab projec

GREENVILLE TECHNICAL COLLEGE

COURSE TITLE: AUT 142 Automotive Accessories

CREDIT HOURS: Three

## TERMINAL OBJECTIVES

Students who successfully complete the above course will have demonstrated the skills required to accomplish the following objectives:

1. The student will draw a simple air conditioner system and name the five basic parts.
2. The student will describe the purpose and use of air conditioner control units.
3. Given a vehicle with a typical air conditioner system, the student will inspect, evacuate, charge, and leak-test the system using the necessary test equipment.
4. Using the necessary test equipment, the student will diagnose a typical air conditioner system problem.
5. The student will remove and replace air conditioner parts.
6. Given a compressor and the necessary tools, the student will remove and replace the front seal after inspection.
7. Upon completion of assigned textbook study and laboratory demonstration, the student will demonstrate the use of air conditioner services and repair equipment.
8. Given a defective power window or seat system, the student will diagnose the problem and repair as necessary.
9. Given a vehicle defective cruise control system, the student will diagnose and repair as necessary.

Appendix C

THE SCHOOL DISTRICT
OF GREENVILLE COUNTY

GREENVILLE TECHNICAL COLLEGE

TO: All Administrators, Staffs and Faculties, The School District of Greenville County and Greenville Technical College

SUBJECT: Application and Implementation of the Policies and Procedures for the Articulation of Similar Vocational Training Programs of Instruction

Since 1976, The School District of Greenville County and Greenville Technical College have been working toward making the articulation of vocational education programs a viable and valid reality. Through joint efforts in the Occupational Education Articulation Program, The School District of Greenville County and Greenville Technical College fully support the concept of articulation and agree upon the purposes of the articulation program.

This Policies and Procedures Guide has been developed as a joint effort of The School District of Greenville County and Greenville Technical College with the assistance of individuals representing the institutional administrative units, involved faculty, and the local business and industrial community. The Policies and Procedures Guide is designed to assist the articulation of very similar programs of vocational training between the secondary and post-secondary, public, vocational training institutions in Greenville County.

Appreciation is expressed to participants at both institutions for the joint effort of this endeavor.

J. F. Hall
J. F. Hall
Superintendent
The School District of
Greenville County

Thomas E. Barton
Thomas E. Barton
President
Greenville Technical College

# TASK FORCE COMMITTEE
# AGREEMENT TO ARTICULATE
# VOCATIONAL EDUCATION

Articulation provides a system whereby secondary and post-secondary instructors can cooperate effectively in providing a continuous occupational development program where the level and type of vocational training that leads to entry-level employment skills will be clear to instructors, other educators, students, and potential employers.

The concept of articulation and the articulation program are supported fully be The School District of Greenville County and Greenville Technical College which have agreed upon a statement of purpose for the articulation of similar vocational education programs in Greenville County.

The articulation program in Greenville County is a joint effort of The School District of Greenville County and Greenville Technical College to develop a continuous program of vocational training so that students may continue their career preparation without loss of time or waste of effort in repeating tasks which have been learned previously and demonstrated. Articulation program activities are designed to help remove unnecessary gaps or overlap in student learning which may occur when a student completes a secondary vocational program and continues career development at the post-secondary level in a similar occupational field.

To implement articulation, instructor representatives from the participating institutions have met as a task force committee to develop this articulated, performance-based instruction guide which describes the secondary vocational program and which provides the parameters for vertical articulation.

Vertical articulation shall include recognition of the occupational competencies demonstrated by secondary graduates of articulated vocational programs.

It is agreed that...

The task force committee instructor representatives from The School District of Greenville County and Greenville Technical College mutually recognize the value of occupational education provided by each institution.

The task force committee instructor representatives will take the necessary actions, approved by their administrations, to ensure that this agreement to articulate is fulfilled including interpreting the program to students.

It is understood that periodic review of the articulated task objectives, performance actions, minimum standards, and outcome-referenced measures will be necessary to ensure that a valid training program is serving the needs of the community and the students.

Each task force committee participant hereby agrees to notify the others of any changes which modify the articulated, performance-based vocational program described in this guide so that each articulation guide, and where appropriate the articulation program, may be revised mutually so that articulated occupational training in Greenville County will conform to the minimum standards outlined in this guide.

This agreement to articulate establishes the necessary framework for lateral as well as vertical articulation.

AGREED UPON BY THE TASK FORCE COMMITTEE PARTICIPANTS ON THIS DAY,

April 20, 1988
date

| Name | Institution/School |
|---|---|
|  | Golden Strip Voc Center |
|  | [illegible] Voc Center |
| H. Dennis Mull | Enoree Voc. Center |
|  | Foothills A.V.C. |
|  | GREENVILLE TEC. |

# PHILOSOPHY OF ARTICULATED, PERFORMANCE-BASED INSTRUCTION GUIDE DESIGN

The design of the articulated, performance-based instruction guides and the articulation program is based on a philosophy that the vocational education curriculum should be for career training with few fringe or non-related subjects. The student should be given the basis to do useful skilled work upon graduation and employment. The vocational program graduate should have a background which will allow him/her to learn and advance as rapidly as possible on the job, but it should not include subject matter which will not be applicable to his/her work for years. When subject matter is introduced that will not be applicable to the graduate's work for years, it may put the graduate out of perspective. The result might be that the graduate may try to force applications which do not exist, simply because the information is in his/her repertoire. Thus, the purpose of vocational training by the articulated, performance-based instruction guides is to prepare graduates for successful entry into a skilled trade.

To ensure that the design of the articulated, performance-based instruction guides is conforming to the philosophies of both the secondary and post-secondary institutional participants, a periodic review of the guide design and philosophy is recommended.

## PURPOSES OF THE ARTICULATED INSTRUCTION GUIDE

The articulated instruction objectives guide are is expected to serve the following purposes:

1. The guide serves as the primary vehicle for the articulation of subject matter in similar vocational training programs between the vocational education centers, high schools, and Greenville Technical College through use by instructors at both levels as a reference in preparing instruction.

2. The guide provides a listing of the minimum tasks that a student or worker is expected to perform in the conduct of a specific level job in the area of vocational training or work of concern.

3. The guides identify the primary detailed instruction objectives, performance objectives which are based upon the task listings. The tasks are listed in the sequence of complexity, with the least complex task being listed first, except where a task must be performed as a prerequisite to performance of another task.

[illegible] The guides identify the tasks performed (actions, steps, sets of skills) and related technical information which must be taught and learned to accomplish each major instruction objective. The tasks performed represent the minimum skills and related information required for adequate occupational proficiency in the performance objectives.

5. The guides designate the instructional contact hours necessary to provide the required instruction, as required by appropriate educational agencies or offices and as estimated by the instructor-participants on the Vocational Articulation Project Task Forces, and based on the time required to teach the average learner to perform the task. The time estimated is based on having the essential equipment, facilities and instructional aids required to provide the instruction, whenever the class size is limited to an acceptable number.

6. The guides identify the performance standards to be met for occupational proficiency in the task. Performance standards used are those considered to be minimum business or industry standards. The ability to meet the listed standards of performance will be considered as qualification for advanced instruction in the vocational program.

7. The guides provide direction in the conduct of sequential vocational competency instruction by modules or job tasks, resulting in qualification by the learner to perform limited skill specialist jobs of

progressively higher skills until the program objective is reached (i.e., file clerk to executive secretary, etc.). As the student becomes proficient in the performance of tasks in successively more complex modules, more marketable competencies are gained and may be identified as the lower job qualifications of a specialist.

Through this procedure, even the slower student is provided an opportunity to eventually gain sufficient skills to perform adequately as a specialist at some level in the vocational field, even if the student is unable to complete the total program of training.

The standardized sequence of activities of the vocational instruction modules will facilitate lateral articulation between vocational education centers in the School District and will simplify vertical articulation when training is continued at Greenville Technical College articulating to employers.

8. The guides provide a descriptive listing of equipment required to conduct the program of vocational training. The equipment listed is considered to be the type and quantity essential for the conduct of instruction to prepare students for entry-level employment in the vocational field. It may be necessary to delay teaching some tasks involving special equipment, if that equipment is not available at all instructional sites, or to move students and equipment together as necessary to teach skills.

9. The guide provides information about requirements or limitations that typically are involved in the performance of the task, environmental conditions and physical demands, and able to perform the task.

10. The guides provide a list of standardized performance test items/ and outcome-referenced measures to be used in the determination of vocational proficiency. As long as the specifics are not provided, the test items listed cannot be compromised easily and could serve as study guides.

11. The tasks listed in the guide are the minimum requirements for job qualification under average circumstances in a regional market. It is understood that there may be unlisted tasks that some employers may require the worker to do in the occupation, when in their employment. In addition, there may be unlisted tasks, such as mental process tasks, that are not stated but that may occur and that should be considered in instructional planning or testing.

    Instructors may teach skills and related technical information other than what is shown in the guides. Provision of additional information should be limited to the students who have completed the requirements for the tasks emphasized in the instructional guides. The change of tasks in the guides should be based on task force committee agreement to ensure lateral and vertical articulation.

12. It is expected that there will be updating and correction of items in the articulated instruction guide. Participants are to be sure that the contents are valid and consistent with business and industry requirements. Recommendations should be submitted to the Vocational Articulation Program office which will assemble and present them to the appropriate committee for review and possible adoption.

13. Typically, the teacher/instructor should not plan to conduct instruction in a given articulated module unless the capability exists to conduct all of the instruction to meet the instructional objectives, with the result that the successful student is qualified to perform the tasks identified within the module.

14. An underlying philosophy in vocational training is that it is better to prepare the student to be fully qualified to perform all of the tasks in a limited group of modules in a vocational field and be qualified at a lower job level rather than to be only familiar with a large number of task descriptions or duties and qualified to perform none of them fully. For higher levels of job qualification beyond the secondary level, the student or worker is encouraged to enroll at Greenville Technical College.

15. Generally, vocational programs will include certain basic modules or courses of instruction without which the student would not be considered vocationally qualified at any level. Basic modules typically will be identified and taught early in the program sequence.

16. The instruction guides provides information essential to help the vocational student who completes training at the secondary level and continues career development training at the post-secondary level in a similar program receive appropriate credit for the articulated vocational training that has been mastered at the secondary level.

Appendix G

## DEFINITIONS OF TERMS

The following definitions of terms are applicable to the articulated, performance-based instruction guides developed as products of the Occupational Education Articulation Program.

| | |
|---|---|
| Behavior: | The actions of a person (specifically, job or job training actions). Behavioral actions include both overt, those that can be observed, and covert, those not observable outwardly. Performance may be interchanged with behavior in the project. (See also Performance Actions). |
| Concept: | A group of ideas that may be classed together or that are similar. |
| Criteria: | A standard by which performance may be measured, usually considered the minimum standard. |
| Domain: | A cluster of related jobs. |
| Duty: | One of the distinct major activities involved in the work performed and comprising related tasks. |
| Evaluation: | When comparison is made between a measurement and a standard and judgment is passed on the comparison. |
| Item: | A single stimulus or stimulus pattern that calls for a single response or set of responses. It is one sample of behavior or performance. The response may be simple or complex. |
| Job: | The duties or tasks actually performed by a specified individual. |
| Knowledge: | In this project, knowledge refers to acquired covert behavior which facilitates skills and performance, such as the theoretical information of what should be done under given circumstances, and in what order of sequence performance should occur to accomplish the objective. |
| Measurement: | The process of determining the extent some characteristic is associated with the student. |
| Module: | Modules in the pilot Drafting and Business and Office Education curriculum modifications in the Occuptional Education Articulation Program have been designed to |

coincide secondary level training with post-secondary level similar areas of training.

Another method of developing modules might be for modules to represent an identifiable, complicated task or job area involving a number of sub-tasks such as "Electrical Systems" in Automotive Mechanics.

Norm-referenced Evaluation: In norm-referenced evaluation, measures are dependent on a relative standard. Measures compare the capabilities of one student to those of other students.

Objective: (See Performance Objective) A stated desired outcome of training or the end result of the job, task, or performance actions. Objectives referred to in this project will be terminal objectives, generally representing a specific job function.

Occupational Education: An organized sequence of learning experiences consisting of vocational theory, practice, and skills taught to students on a regular or systematic basis.*

*Reference: Standards of the Delegate Assembly (Atlanta: Southern Association of Colleges and Schools, Commission on Occupational Education, December, 1972) p. 12.

Outcome-referenced Evaluation: Outcome-referenced, or criterion-referenced, measurement provides a standard of achievement for the individual as compared with specific behavioral objectives and therefore provides information about the degree of competence attained by the student.

The outcome-referenced measure is a performance or other measure based upon a performance objective, the accomplishment of which measures attainment of that objective.

Performance: Performance is used in this project to refer to a job or task which results from a set of sequential actions or steps.

Performance Actions: A series of steps, generally arranged in a sequence ordinarily followed, which when completed may result in the accomplishment of a performance objective (performance of a task).

Performance actions may be referred to as a set or sets of skills, functions, or steps. V-TEC (Vocational-Technical Education Consortium of States) catalogs generally describe performance actions in the "performance guide" of their format.

Articulated, Performance-based Instruction Guide: A comprehensive collection of performance objectives, performance actions to obtain those objectives, suggested hours for instruction (for planning purposes), performance standards, related technical information, and outcome-referenced measures, as well as general secondary level and post-secondary level descriptions of similar courses for the purposes of aiding lateral and vertical articulation concerning the subject area.

Performance-based Instruction: Performance-based (competence-based) instruction is based on the competencies or tasks performed by on-the-job workers. Everything in a performance-based instruction system is made public beforehand. There are no surprises for student, teacher, counselor, or employer. When the student begins a program, information is available to tell the student exactly what competencies are expected to be developed as a result of the instructional program, how and against what standards or criteria the student will be evaluated, and how the student's competencies will be communicated to the student, instructors, and to employers. A performance-based instructional system tells the student exactly what the student must learn, teaches the student that skill or knowledge, and then tests on mastery of that specific competence.

Performance Objective: A statement in precise, measurable terms of a particular behavior to be exhibited by a learner under specified conditions. It possesses each of the elements or characteristics specified below:

Conditions under which the performance is to take place.

Behavior Desired or expected of the student (things to be done, the performance desired).

Standards to determine how well the performance is to be done (criteria).

Performance Test: A performance test requires the student to demonstrate (master) the desired behavior of the objective (accomplish a job-like task) under controlled conditions and according to predetermined standards. The controlled conditions allow the student to demonstrate the desired behavior and the conditions remain consistent from student to student.

Skill: Primarily, skill refers to overt, observable performance, however, it is recognized that there are covert skills required in some performances.

Step: Step is used to refer to a task or action, generally as a sequence of steps involved in the accomplishment of a performance objective or job.

Systems Approach: The systems approach to instruction emphasizes the specification of instructional objectives, precisely controlled learning experiences to achieve the objectives, criteria for performance, and evaluative information.

Task: A task is a set of skills (set or sets of functions, actions, or steps) the student must perform to accomplish the job (training). A task may be described as a logically related set of actions necessary or required to complete the job objective. Several tasks could be referred to as a duty.

Task Analysis: Task analysis is breaking down a learning task (objective) into component tasks each of which must be mastered as a prerequisite to mastery of the total job.

Task List: A listing of tasks (performance objectives) performed by incumbent workers (students in training) within a domain of interest (course of study).

Test: An event during which the student is asked to demonstrate some aspect of knowledge or skill is a test. It can be a single test item, but usually it consists of several items.

## INSTRUCTIONS FOR ANSWERING OUTCOME-REFERENCED TEST ITEMS

Typically, eleven (11) different types of outcome-referenced test items may be used in the competency test.

1. True-False
2. Completion (Fill-in Blanks)
3. A Combination of True-False and Completion
4. Multiple-Choice
5. Matching
6. Identification
7. Short Answer
8. Long Answer
9. Program Product of Performance Test
10. Simulated Performance Test
11. Actual Performance Test

An example of each type of test item is included. Carefully study the illustration test item and the directions for answering the question. These directions will not be given again. Your test questions may vary slightly in the format, however, the instruction should be applicable. Where necessary, the instructor will supplement these instructions for answering outcome-referenced test items.

Do not guess. Guessing does not add to your knowledge, even if you happen to guess right. If you do not know the answer skip the test item and go to the next question. Remember: Enter your answers in the blanks provided on the separate answer sheet, if used.

---

### 1. TRUE-FALSE

Directions: Read the statement carefully. Decide whether it is true or false. Answer by marking T or F in the blank provided to the right (or, if answer sheet requires, mark "X" in the appropriate (T) or (F) parenthesis, or "circle" T or F).

Example: Lumber shrinks across the grain of the board. (T) (F)

### 2. COMPLETION (Fill-in Blanks)

Directions: Complete the statement by printing on the blank line the word or words which make a complete and correct statement.

Example: Proper edge spacing will restrict __?__ and ensure good weld penetration. distortion

3. COMBINATION OF TRUE-FALSE/COMPLETION

Directions: If the statement is correct, in the parenthesis mark (T) or answer true, as required. If the statement is incorrect, mark (F) in the parenthesis and fill in the blank provided with the appropriate word or term which, if substituted for the underlined word, would make the statement correct.

Example: A pantry chef usually is the head chef's first assistant. (T) (F)

sous

4. MULTIPLE-CHOICE

a. Directions: You are given three or four choices from which to make a complete and correct statement. In the blank answer space provided, write in the "letter" indicate the best choice.

Example: The head chef's first assistant is a __?__.

a. junior chef
b. sous chef
c. pantry cook

b

b. Negative Answer Multiple-Choice

Directions: If the multiple-choice question includes the word EXCEPT, you should look for the choice that does not fit the question. Read the entire question carefully before you choose your answer.

Example: All of these could cause high starter current draw EXCEPT:

a. work starter bushing
b. bad starter relay
c. grounded field coils
d. grounded armature

b

5. MATCHING:

Directions: For each given item in the left hand column, match it with the appropriate item from the right hand column. Write the letters of the correct or best answer in the appropriate blanks.

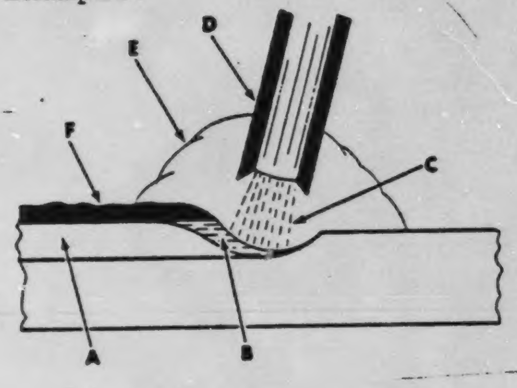
Example: Match these metric terms on the left with their proper equivalents.

| | | | |
|---|---|---|---|
| b | deca | a. | thousands |
| c | meter | b. | tens |
| a | kilo | c. | units of length measurement |

6. IDENTIFICATION

Directions: Identify each labeled part of the illustration below and write the name next to the appropriate letter in the blank provided.

Example:



a. base metal
b. molten metal
c. arc
d. electrode
e. gas shield
f. slag

7. SHORT ANSWER

Directions: Write the correct answer in the blank provided.

Example: What type of electrode is best for vertical and overhead welding? fast-freeze

8. LONG ANSWER

Directions: Using as few words as possible, write the answer to the question in the blank provided.

Example: What should be done if the electrode welds fast to the work?

"Electrode should be broken loose by twisting or bending the holder."

9. PROGRAM PRODUCT OR PERFORMANCE TEST

Definition: Concrete project or production accomplishments during training are used to test knowledge or skill. Typically, test pressures are missing and the student may have had help in completing the task.

Directions: Instructor will observe student during training and by checklist or rating scale will rate student's performance or knowledge.

Example: Given an oven for baking, food items, and necessary implements and equipment; load the oven with foods to be baked. All items on a checklist used to rate performance must receive an acceptable rating. The task must be accomplished within 15 minutes.

CHECKLIST

(Load Oven Racks)

| ACTIVITY | RATING | |
|---|---|---|
| | Acceptable | Unacceptable |
| 1. Gathered needed supplies. | | |
| 2. Used needed supplies. | | |
| 3. Pulled oven rack partially out while loading. | | |
| 4. Stacked oven shelves 8 inches apart for baking. | | |
| 5. Placed food on rack so that heat circulated adequately. | | |
| 6. Followed appropriate safety precautions. | | |

## 10. SIMULATED PERFORMANCE

Definition: Contrived situation, resembling tasks the graduate will be required to do on the job. This form of test is useful for evaluating transferable skills such as reasoning, attitudes, and psychomotor skills necessary for occupational success.

## 11. ACTUAL PERFORMANCE TEST

Definition: Exhibits the advantage of realism, but may be too late to help either the student or the vocational program correct failures.

Example: Given an automobile with a leaking pinion seal, access to proper tools and equipment, replacement parts, and service manual; replace the pinion seal according to manufacturer's recommended procedures. The job should be completed within 2 hours. The manufacturer's specifications must be met and the completed job must meet the instructor's standards.

Appendix I

## THIS DOCUMENT AND BINDER ARE THE PROPERTY OF THE SCHOOL DISTRICT OF GREENVILLE COUNTY OR GREENVILLE TECHNICAL COLLEGE

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Task Number or Page Number

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Greenville, SC 29605
(or)
Consultant, Vocational Education
The School District of Greenville County
(or)
Associate Vice President for Education
Greenville Technical College

## BINDER DESIGN

(Occupational Education Articulation Program)

The binder design is simple and straightforward.

Two triangular figures, in balance, represent the two institutions participating in articulation.

Two levels of training are represented by the placement of the triangular figures and the identification of the two institutions.

Horizontal and vertical lines represent lateral and vertical articulation.

The diagonal across the design represents the progressive movement in career development for successful job performance.

The two figures are not closed when they face, but allow for interaction and are linked by the document title: Articulated, Performance-based Instruction Guide.

The binder design was developed by Ed Henderson Jr., Coordinator, Occupational Education Articulation Program.

## UNIT 1.0 - AUTOMOTIVE MECHANICS - SHOP MATH

## OUTCOME-REFERENCED TESTS

Task E.01

TRUE/FALSE

1. ___ Units of the English system cannot be converted to units of the metric system.

2. ___ The most accurate measurements for general automotive work are possible with a micrometer.

3. ___ Micrometers are available with English or metric scales.

4. ___ The inside of a cylinder is measured with an inside micrometer.

5. ___ The space between two objects is measured with a feeler gauge.

MULTIPLE CHOICE

1. Which of the following is one thousandth of an inch:

___ a. 1.0 inch
b. 0.1 inch
c. 0.01 inch
d. 0.001 inch

2. Which of the following is/are metric system prefixes:

___ a. kilo
b. milli
c. centi
d. all of the above

3. The outside of a shaft is best measured with:

___ a. an outside micrometer
b. an inside micrometer
c. a telescoping gauge
d. a dial indicator

4. A very small round opening is best measured with:

___ a. an inside micrometer
b. a telescoping gauge
c. a small hole gauge
d. a dial indicator

Unit 1.0 - Automotive Mechanics - Shop Math

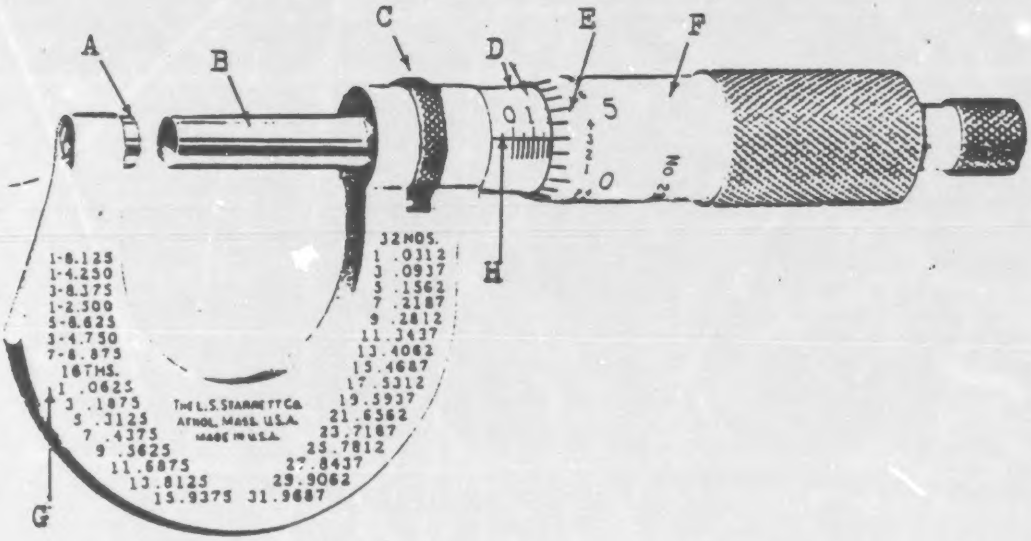
Multiple Choice (Con't.)

5. Runout is best measured with:

___ a. an inside micrometer
b. an outside micrometer
c. a telescoping gauge
d. a dial indicator

## IDENTIFY

On the following drawing of a micrometer, label the part identified by blanks.


A
B
C
D
E
F
G
H
0 1
5
0
No 2
1-8.125
1-4.250
3-8.375
1-2.500
5-8.625
3-4.750
7-8.875
16THS.
1 .0625
3 .1875
5 .3125
7 .4375
9 .5625
11.6875
13.8125
15.9375
32NDS.
1 .0312
3 .0937
5 .1562
7 .2187
9 .2812
11.3437
13.4062
15.4687
17.5312
19.5937
21.6562
23.7187
25.7812
27.8437
29.9062
31.9687
THE L.S. STARRETT CO.
ATHOL, MASS. U.S.A.
MADE IN U.S.A.

A. ______________

B. ______________

C. ______________

D. ______________

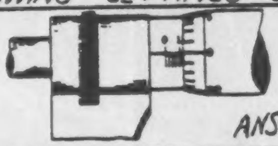
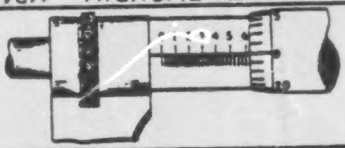
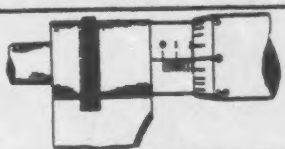
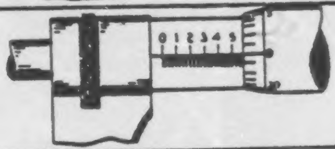
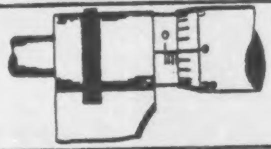
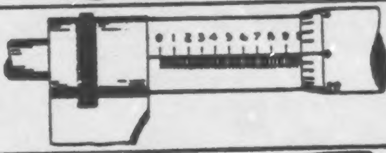
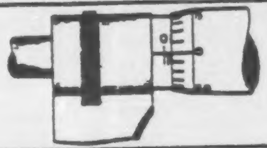
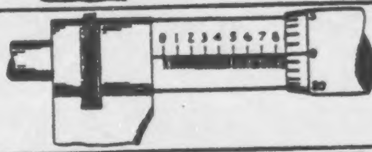
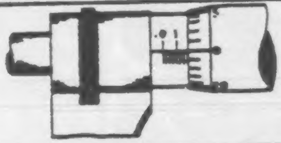
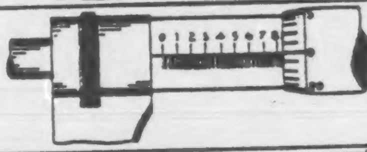
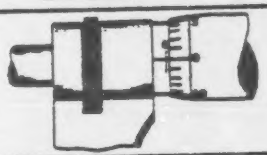
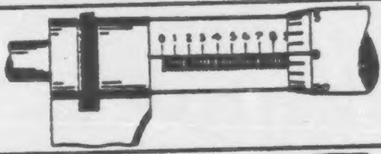
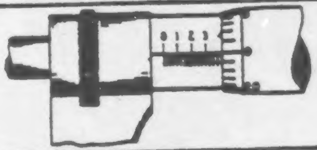
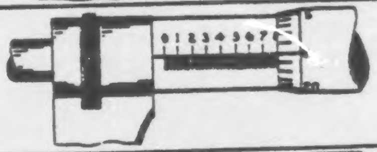
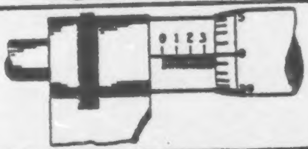
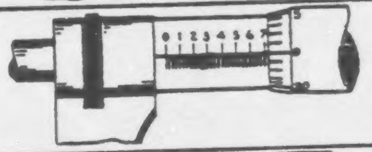
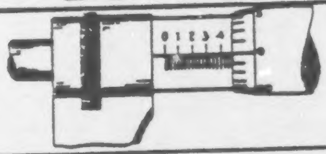
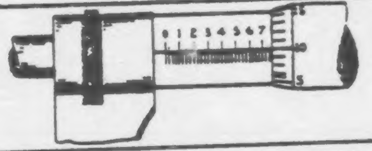
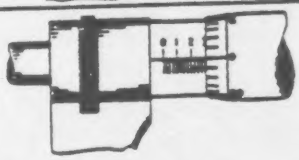
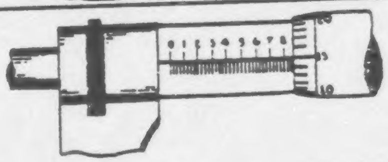
E. ______________

F. ______________

G. ______________

H. ______________

## MICROMETER READING TEST No. 1
WHAT ARE THE READINGS IN THOUSANDTHS OF AN INCH OF THE FOLLOWING SETTINGS ON THE ONE INCH MICROMETER?

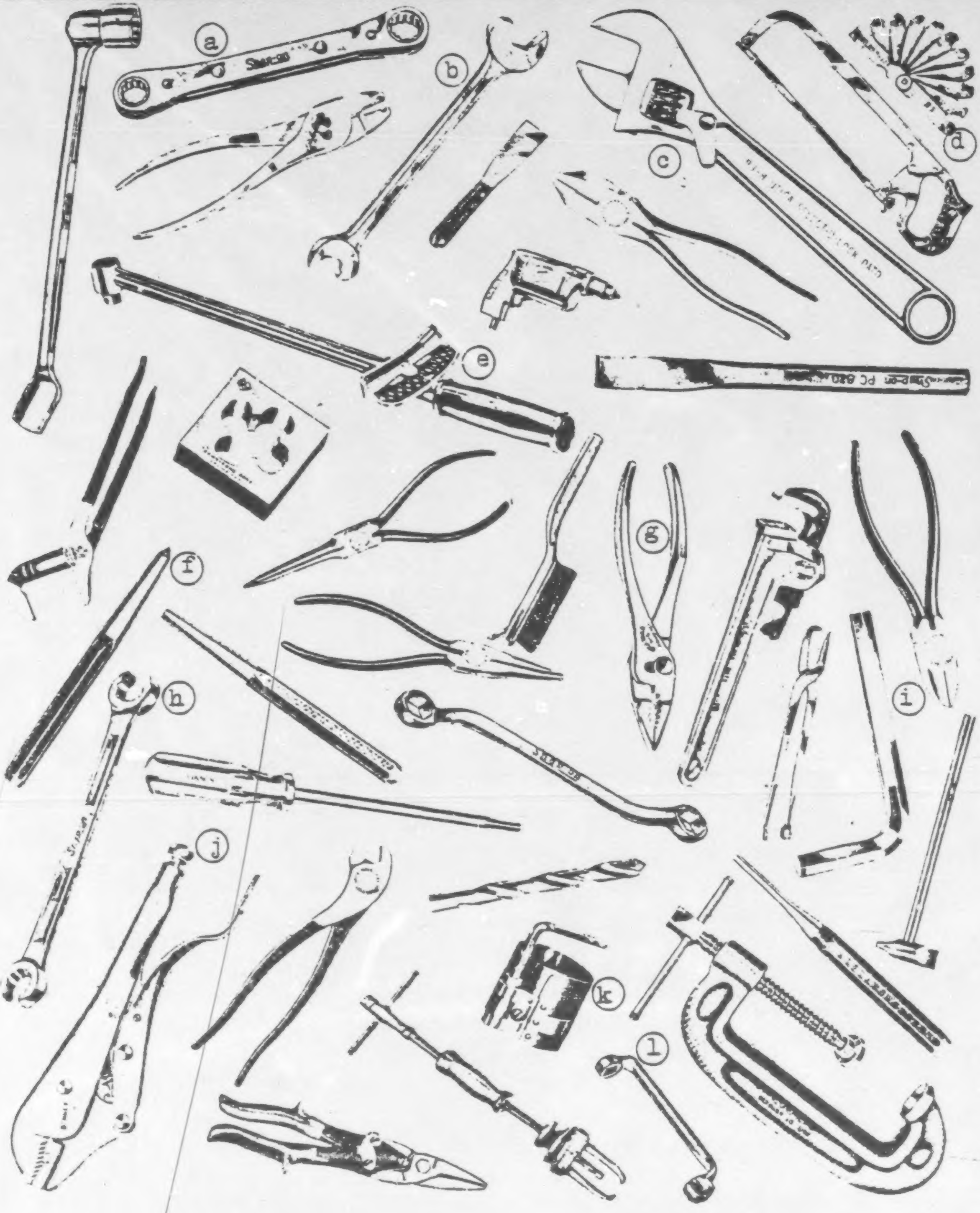
| | |
|---|---|
| 1.  ANS. = | 11.  |
| 2.  | 12.  |
| 3.  | 13.  |
| 4.  | 14.  |
| 5.  | 15.  |
| 6.  | 16.  |
| 7.  | 17.  |
| 8.  | 18.  |
| 9.  | 19.  |
| 10.  | 20.  |

## UNIT 1.0-F - AUTOMOTIVE MECHANICS - TOOLS AND EQUIPMENT

## OUTCOME-REFERENCED TESTS

### IDENTIFY

Refer to the following drawings and identify the tools marked with circled letters. The correct terminology used in automotive mechanics (class or textbook) must be used.


a
b
c
d
e
f
g
h
i
j
k
l

1. a. ______________________

b. ______________________

c. ______________________

d. ______________________

e. ______________________

f. ______________________

g. ______________________

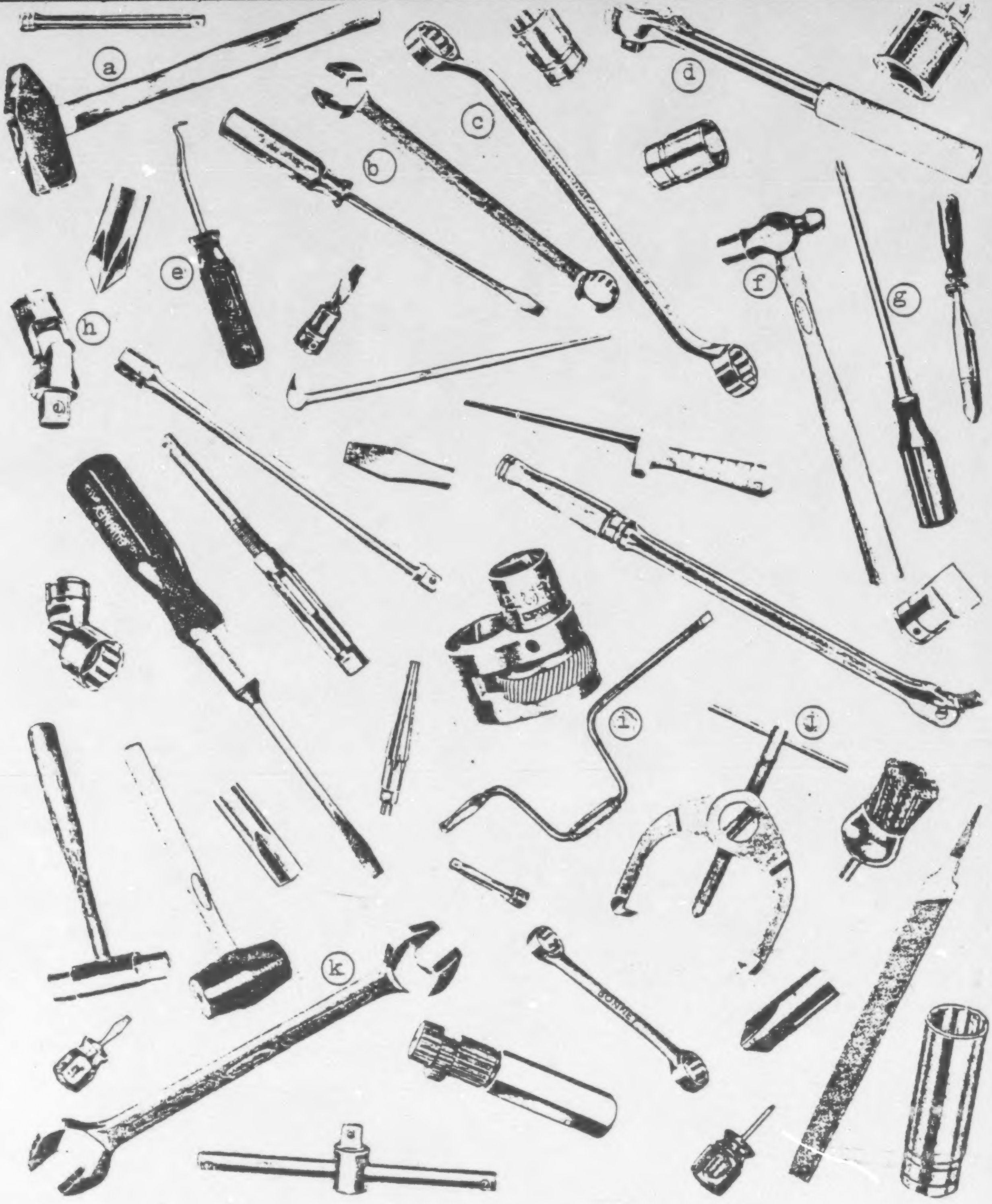
h. ______________________

i. ______________________

j. ______________________

k. ______________________

l. ______________________


a
d
c
b
e
h
f
g
i
j
k

2. a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________

f. ____________________

g. ____________________

h. ____________________

i. ____________________

j. ____________________

k. ____________________

## UNIT 1.0-G - AUTOMOTIVE MECHANICS - FASTENERS

## OUTCOME-REFERENCED TESTS

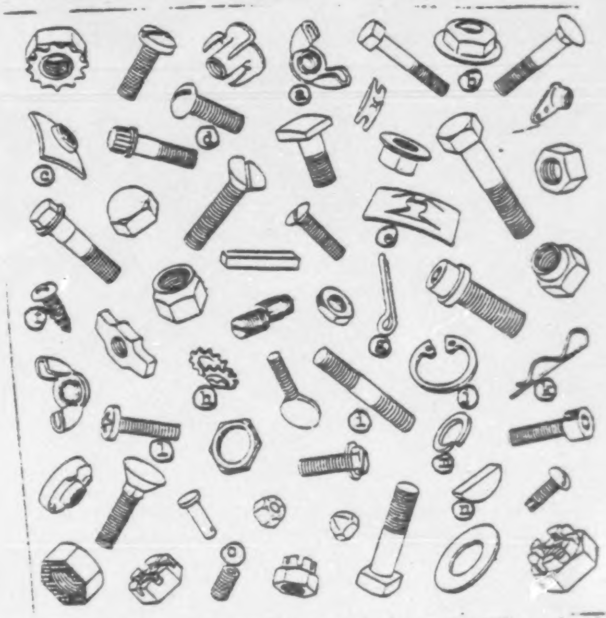
### TRUE/FALSE

1. ___ A bolt is used in a threaded hole.
2. ___ A stud is a fastener with threads at both ends.
3. ___ A cotter pin is used with a castellated nut.
4. ___ Metric and English fasteners may be interchanged.
5. ___ The strength of a fastener is given as a grade marking or number.

### IDENTIFY

The drawing below contains various fasteners used in automotive service work. Match the fasteners circled with the appropriate terminology by placing the number next to the terminology in the blank next to the letters.

a. ___
b. ___
c. ___
d. ___
e. ___
f. ___
g. ___
h. ___
i. ___
j. ___
k. ___
l. ___
m. ___
n. ___
o. ___



1–Flange-lock nut. 2–Fillister head machine screw. 3–Barrel prong nut. 4–Wing nut. 5–Cap screw. 6–Pal nut. 7–Carriage bolt. 8–Spring nut. 9–12-point head bolt. 10–Round head machine screw. 11–Askew-head bolt. 12–Single thread nut. 13–Flanged nut. 14–Cap screw. 15–Anchor nut. 16–Plain hex nut. 17–Hex flange screw. 18–Acorn (cap) nut. 19–Flat head screw. 20–Small flat head screw. 21–Speed nut. 22–Sheet metal screw. 23–Locking nut. 24–Key. 25–Offset (eccentric) stud. 26–Thin nut. 27–Cotter pin. 28–Socket head bolt. 29–Locking nut. 30–Wing nut. 31–Specialty nut. 32–Toothed lock washers. 33–Thumbscrew. 34–Stud. 35–Snap ring. 36–Spring lock pin. 37–Cross head machine screw. 38–Panel nut. 39–Flanged hex slotted head screw. 40–Split lock washer. 41–Hex socket head bolt. 42–Welded nut. 43–Plow bolt. 44–Clevis pin. 45–Open top acorn nut. 46–Closed top acorn nut. 47–Square head cap screw. 48–Woodruff key. 49–Self-tapping screw. 50–Serrated nut. 51–Slotted nut. 52–Set screw. 53–Castle nut. 54–Flat washer. 55–Castle nut.

## UNIT 1.0-H - AUTOMOTIVE MECHANICS - SHOP PRACTICES AND PROCEDURES

## OUTCOME-REFERENCED TESTS

### TRUE/FALSE

1. ___ A repair manual covers several different makes of automobiles.

2. ___ A shop manual covers one model of vehicle.

3. ___ The most detailed information is found in the repair manual.

4. ___ Prices charged for parts and labor are found in the flat rate manual.

5. ___ A repair manual may be used to estimate a job.

### MULTIPLE CHOICE

1. Measurements needed for repair are called:

___ a. specs
b. specifications
c. both a and b
d. neither a nor b

2. The book that comes with a new car is the:

___ a. owner's manual
b. shop manual
c. repair manual
d. flat rate manual

3. Repair procedures for one type of car are found in the:

___ a. owner's manual
b. shop manual
c. repair manual
d. flat rate manual

4. Repair procedures for several different makes of cars may be found in the:

___ a. owner's manual
b. shop manual
c. repair manual
d. flat rate manual

5. The most up-to-date information may be found in the:

____ a. owner's manual
b. shop manual
c. repair manual
d. service bulletin

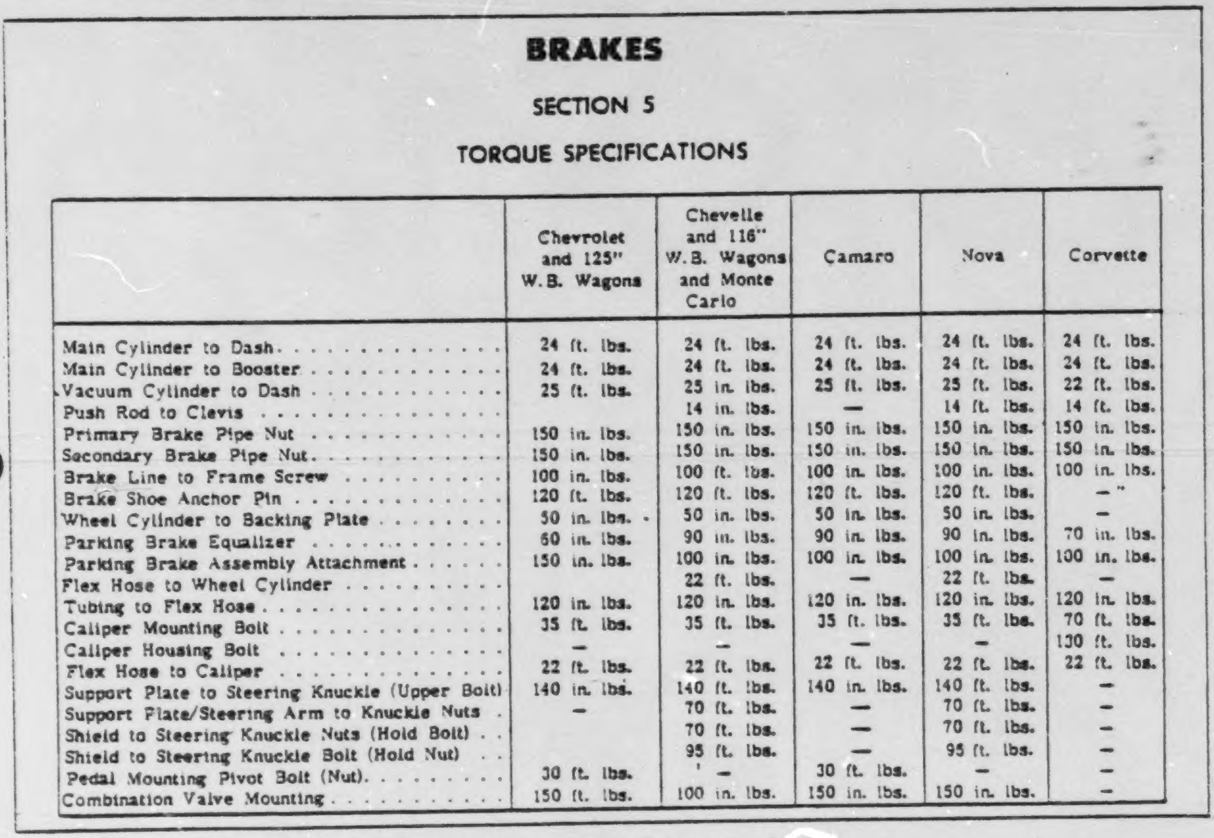
Student ________________________ Date __________

Section ________________________ Instructor's Check ______

## PERFORMANCE JOBS SHEET USING SERVICE MANUALS

Performances: Looking Up Specifications

Use the manual page reproduced below to look up the assigned specifications at the bottom of this page.



## BRAKES

### SECTION 5

### TORQUE SPECIFICATIONS

| | Chevrolet and 125" W.B. Wagons | Chevelle and 116" W.B. Wagons and Monte Carlo | Camaro | Nova | Corvette |
|---|---|---|---|---|---|
| Main Cylinder to Dash | 24 ft. lbs. | 24 ft. lbs. | 24 ft. lbs. | 24 ft. lbs. | 24 ft. lbs. |
| Main Cylinder to Booster | 24 ft. lbs. | 24 ft. lbs. | 24 ft. lbs. | 24 ft. lbs. | 24 ft. lbs. |
| Vacuum Cylinder to Dash | 25 ft. lbs. | 25 in. lbs. | 25 ft. lbs. | 25 ft. lbs. | 22 ft. lbs. |
| Push Rod to Clevis | | 14 in. lbs. | — | 14 ft. lbs. | 14 ft. lbs. |
| Primary Brake Pipe Nut | 150 in. lbs. | 150 in. lbs. | 150 in. lbs. | 150 in. lbs. | 150 in. lbs. |
| Secondary Brake Pipe Nut | 150 in. lbs. | 150 in. lbs. | 150 in. lbs. | 150 in. lbs. | 150 in. lbs. |
| Brake Line to Frame Screw | 100 in. lbs. | 100 ft. lbs. | 100 in. lbs. | 100 in. lbs. | 100 in. lbs. |
| Brake Shoe Anchor Pin | 120 ft. lbs. | 120 ft. lbs. | 120 ft. lbs. | 120 ft. lbs. | — |
| Wheel Cylinder to Backing Plate | 50 in. lbs. | 50 in. lbs. | 50 in. lbs. | 50 in. lbs. | — |
| Parking Brake Equalizer | 60 in. lbs. | 90 in. lbs. | 90 in. lbs. | 90 in. lbs. | 70 in. lbs. |
| Parking Brake Assembly Attachment | 150 in. lbs. | 100 in. lbs. | 100 in. lbs. | 100 in. lbs. | 100 in. lbs. |
| Flex Hose to Wheel Cylinder | | 22 ft. lbs. | — | 22 ft. lbs. | — |
| Tubing to Flex Hose | 120 in. lbs. | 120 in. lbs. | 120 in. lbs. | 120 in. lbs. | 120 in. lbs. |
| Caliper Mounting Bolt | 35 ft. lbs. | 35 ft. lbs. | 35 ft. lbs. | 35 ft. lbs. | 70 ft. lbs. |
| Caliper Housing Bolt | — | — | — | — | 130 ft. lbs. |
| Flex Hose to Caliper | 22 ft. lbs. | 22 ft. lbs. | 22 ft. lbs. | 22 ft. lbs. | 22 ft. lbs. |
| Support Plate to Steering Knuckle (Upper Bolt) | 140 in. lbs. | 140 ft. lbs. | 140 in. lbs. | 140 ft. lbs. | — |
| Support Plate/Steering Arm to Knuckle Nuts | — | 70 ft. lbs. | — | 70 ft. lbs. | — |
| Shield to Steering Knuckle Nuts (Hold Bolt) | | 70 ft. lbs. | — | 70 ft. lbs. | — |
| Shield to Steering Knuckle Bolt (Hold Nut) | | 95 ft. lbs. | — | 95 ft. lbs. | — |
| Pedal Mounting Pivot Bolt (Nut) | 30 ft. lbs. | — | 30 ft. lbs. | — | — |
| Combination Valve Mounting | 150 ft. lbs. | 100 in. lbs. | 150 in. lbs. | 150 in. lbs. | — |

1. Torque for Camaro vacuum cylinder to dash ____________________
2. Torque for Nova push rod to clevis ____________________
3. Torque for Corvette main cylinder to dash ____________________
4. Torque for Chevelle brake shoe anchor pin ____________________
5. Torque for Chevrolet caliper mounting bolt ____________________
6. Torque for Corvette caliper housing bolt ____________________

Using the following specifications page from a Ford Motor Company Specification Manual, supply the correct answers on the accompanying test.

**GENERAL SPECIFICATIONS**

| Engine | Compression Ratio | Bore and Stroke | Compression Pressure PSI (Sea Level) @ Cranking Speed | Oil Pressure-Hot @ 2000 RPM | Firing Order | Belt Tension (Ft–lb) ① |
|---|---|---|---|---|---|---|
| 200 | N.A. | 3.68 x 3.13 | When checking compression, take the highest compression reading and compare it to the lowest reading. The lowest reading must be within 75% of the highest. | 30-50 | 1-5-3-6-2-4 | New 140 Used 110 |
| 250 | N.A. | 3.68 x 3.91 | | 40-60 | | |

① All belts. Used belt is any in operation for 10 minutes.

**CYLINDER HEAD**

| Engine | Combustion Chamber Volume | Valve Guide Bore Diameter (Standard Intake and Exhaust) | Valve Seat Width | | Valve Seat Angle | Valve Seat Runout (Maximum) | Valve Arrangement (Front to Rear) | Gasket Surface Flatness ① |
|---|---|---|---|---|---|---|---|---|
| | | | Intake | Exhaust | | | | |
| 200, 250 | 59.4-62.4 | 0.3115-0.3125 | 0.060-0.080 | 0.070-0.090 | Intake and Exhaust 45° | 0.0015 | E-I-I-E-I-E<br>E-I-E-I-I-E | 0.003 in any 6 inches<br>0.007 overall |

① Head Gasket Surface Finish R.M.S. 60-150

**VALVE ROCKER ARMS, ROCKER ARM SHAFT, PUSHRODS AND TAPPETS**

| Engine | Rocker Arm Shaft O.D. | Rocker Arm Bore Diameter | Rocker Arm Lift Ratio | Valve Push Rod (Maximum Runout) | VALVE TAPPET OR LIFTER | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Standard Diameter | Clearance To Bore ① | Hydraulic Lifter Leakdown Rate | Collapsed Tappet Gap | |
| | | | | | | | | Allowable | Desired |
| 200 | 0.7797-0.7807 | 0.783-0.784 | 1.50:1 | 0.020 | 0.8740-0.8745 | 0.0007-0.0027 | 5-50 Seconds Maximum-Measured at 1/16 inch plunger travel | 0.079-0.209 | 0.079-0.129 |
| 250 | | | | | | | | 0.095-0.195 | 0.095-0.145 |

① Wear Limit–0.005

**VALVES**

| Engine | Valve Stem To Valve Guide Clearance ① | | Valve Head Diameter | | Valve Face Angle ① |
|---|---|---|---|---|---|
| | Intake | Exhaust | Intake | Exhaust | |
| 200 | 0.0008-0.0025 | 0.0010-0.0027 | 1.642-1.660 | 1.381-1.399 | Intake and Exhaust 44° |
| 250 | | | 1.642-1.660 | 1.391-1.399 | |

① Wear Limit 0.0055

① Valve face runout . . . . . . . . . . . . . . Maximum 0.002

**VALVES (Continued)**

| Engine | Valve Stem Diameter | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Standard | | 0.003 Oversize | | 0.015 Oversize | | 0.030 Oversize | |
| | Intake | Exhaust | Intake | Exhaust | Intake | Exhaust | Intake | Exhaust |
| 200 | 0.3100-0.3107 | 0.3098-0.3105 | 0.3130-0.3137 | 0.3128-0.3135 | 0.3250-0.3257 | 0.3248-0.3255 | 0.3400-0.3407 | 0.3398-0.3405 |
| 250 | | | | | | | | |

COMPLETION:

1. The firing order used for engines covered by the given specifications is ______________________________.

2. The valve seat angle given in the specifications is ______________.

3. After installing a new fan belt on the vehicle covered by the given specifications, you allowed the car to warm up for twenty minutes to check the cooling system. Now you are ready to adjust the belt tension. You will set the belt for _______________ft-lb of tension.

4. Do the given specifications cover 4, 6, or 8 cylinder engines: _______________

## UNIT 1.0-I - AUTOMOTIVE MECHANICS - INTRODUCTION TO AUTOMOTIVE SYSTEMS

## OUTCOME-REFERENCED TESTS

IDENTIFY

1. This drawing shows a layout of a typical steering system. Identify, with proper terminology, the labeled steering linkage by placing your answer in the appropriate blanks on the answer sheet.

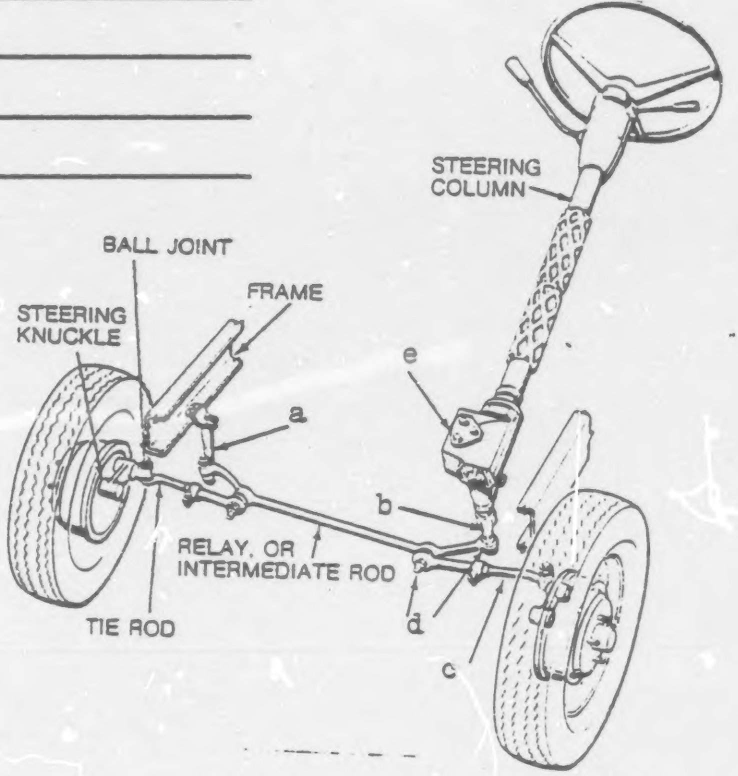
a. ______________________

b. ______________________

c. ______________________

d. ______________________

e. ______________________


STEERING COLUMN
BALL JOINT
FRAME
STEERING KNUCKLE
e
a
b
RELAY, OR INTERMEDIATE ROD
TIE ROD
d
c

2. Label the parts of this conventional ignition system.

a. ____________________

b. ____________________

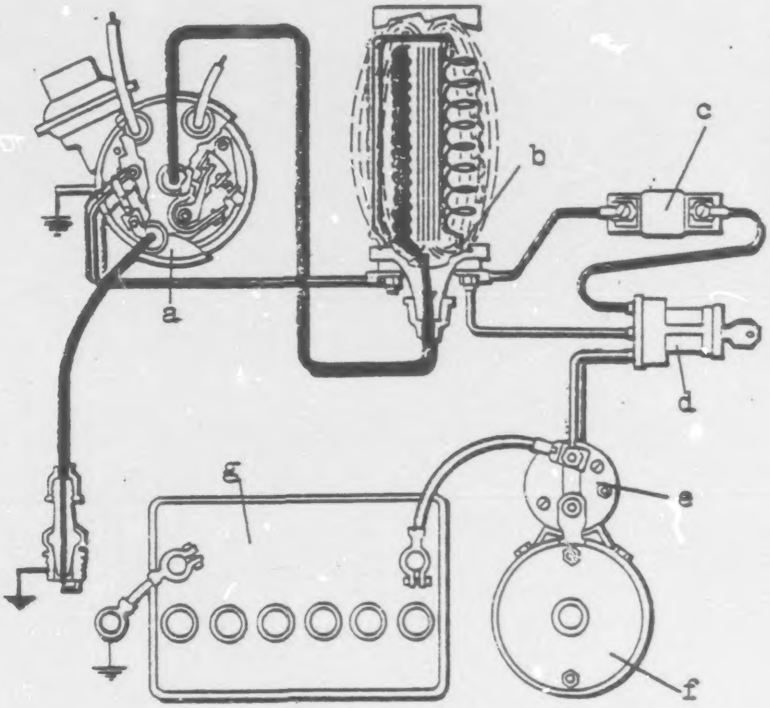
c. ____________________

d. ____________________

e. ____________________

f. ____________________

g. ____________________



## Unit 1.0 - Introduction to Automotive Mechanics

### Answer Sheet

Unit 1.0-E Shop Math

True/False

1.
2.
3.
4.
5.

Multiple Choice

1.
2.
3.
4.
5.

Identify

a. anvil
b. spindle
c. lock nut
d. sleeve numbers
e. thimble marks
f. thimble
g. frame
h. sleeve long line

Unit 1.0-F Tools and Equipment

1. a. ratchet box end
   b. ratch open end
   c. adjustable wrench
   d. feeler gauge
   e. torque wrench

Unit 1.0-F Tools and Equipment (Con't.)

Answer Sheet

f. center punch
g. slip joint plier
h. 12 point tubing wrench
i. diagonal plier (wire cutter)
j. vise grip plier
k. ring compressor
l. cylinder head wrench

2. a. cross peen hammer
b. combination box and open wrench
c. standard length, double offset box
d. socket rachet handle
e. cotter pin puller
f. ball peen hammer
g. phillips head screwdriver
h. socket universal drive joint
i. socket speed handle
j. gear puller
k. open end wrench

Unit 1.0-G Fasteners

True/False

1.
2.
3.
4.
5.

Identify

a. wing nut
b. pal nut
c. spring nut
d. round head machine screw
e. speed nut
f. sheet metal screw
g. cotter pin

## Unit 1.0-G Fasteners (Con't.)

### Answer Sheet

f. sheet metal screw

g. cotter pin

h. tooth locked washers

i. stud

j. snap ring

k. spring lock pin

l. cross head machine screw

m. split lock washer

n. woodruff key

o. set screw

## Unit 1.0-H Shop Practices and Procedures

### True/False

1.
2.
3.
4.
5.

### Multiple Choice

1.
2.
3.
4.
5.

### Performance Job Sheet

1.
2.
3.
4.
5.

# UNIT 2.0 - LUBRICATION AND VEHICLE OPERATING MAINTENANCE

## OUTCOME-REFERENCED TESTS

### TRUE/FALSE

1. ___ The lubrication system circulates oil between moving parts.
2. ___ Oil on the cylinder walls prevents the rings from sealing.
3. ___ Oil helps cool engine parts.
4. ___ Oil carries dirt away from engine parts.
5. ___ Friction can be completely eliminated in an engine.
6. ___ The thicker an oil is the higher its viscosity.
7. ___ Viscosity index describes how much an oil costs.
8. ___ Service rating is a measure of how well an oil works in service.
9. ___ Synthetic oil is made from petroleum by-products.
10. ___ The oil level is measured with a dipstick.

### MULTIPLE CHOICE

1. The thickness or thinness of an oil is its:

   ___ a. viscosity
   b. viscosity index
   c. service rating
   d. none of the above

2. The lowest category of service rating is:

   ___ a. SA
   b. SB
   c. SD
   d. SE

3. The highest category of service rating is:

   ___ a. SA
   b. SB
   c. SD
   d. SE

4. Oil viscosity ratings are set up by:

   ___ a. API
   b. SAE
   c. DIN
   d. all of the above

5. Oil service ratings are set up by:

   ___ a. API
   b. SAE
   c. DIN
   d. all of the above

Student ______________________________ Date ______________

Section ______________________ Instructor's Check ____________

## PERFORMANCE JOB SHEET LUBRICATION SERVICE

PERFORMANCE: Change Engine Oil and Filter

Complete this section:

Make of car ___________ Model ______ Year ____________

Flat Rate Time = _____________________

Time Started = ________ Time Finished = ________ Total Time = _______

### Special Tools, Equipment, Parts, and Materials

|  |  |
|---|---|
| Adjustable wrench, special oil drain plug wrench | _________________ |
| New oil | _________________ |
| New oil filter | _________________ |
| Oil filter tool | _________________ |
| Other | _________________ |

### References

Manufacturer's Shop Manual ______________________________

Repair Manual ______________________________

Service Bulletin ______________________________

### Specifications

Look up and record the recommended amount of oil required for this engine when the oil and filter are changed.

Oil Capacity ______ qts.

Type Oil Recommended ________________________

## Unit 2.0 - Lubrication and Vehicle Operating Maintenance

### Answer Sheet

### True/False

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

### Multiple Choice

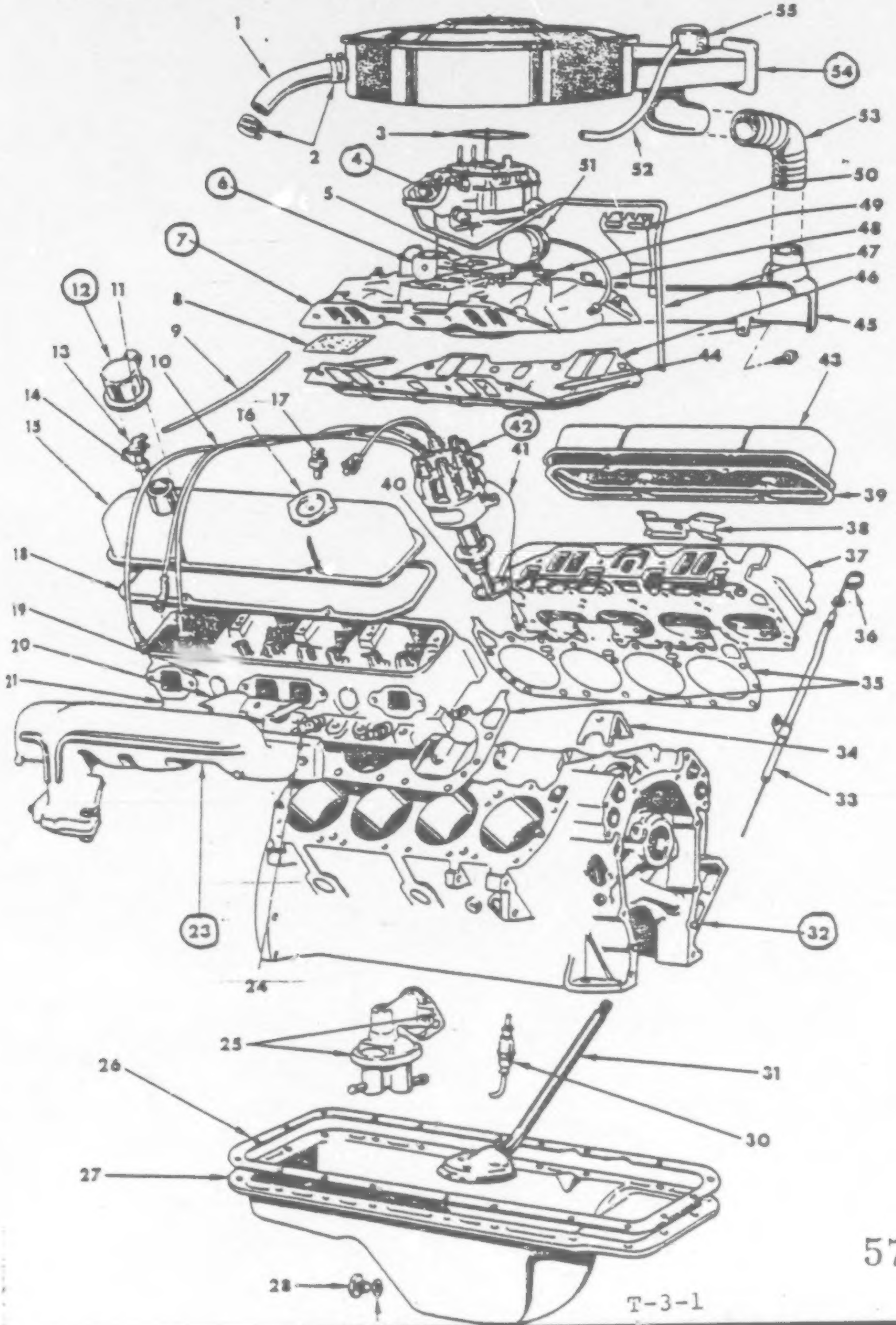
1.
2.
3.
4.
5.

# UNIT 3.0 - AUTOMOTIVE ENGINE MAINTENANCE, REPAIR, AND OVERHAUL

## OUTCOME-REFERENCED TESTS

IDENTIFY

1. In the blanks provided, label the components of the Chrysler eight cylinder 400 engine pictured below.

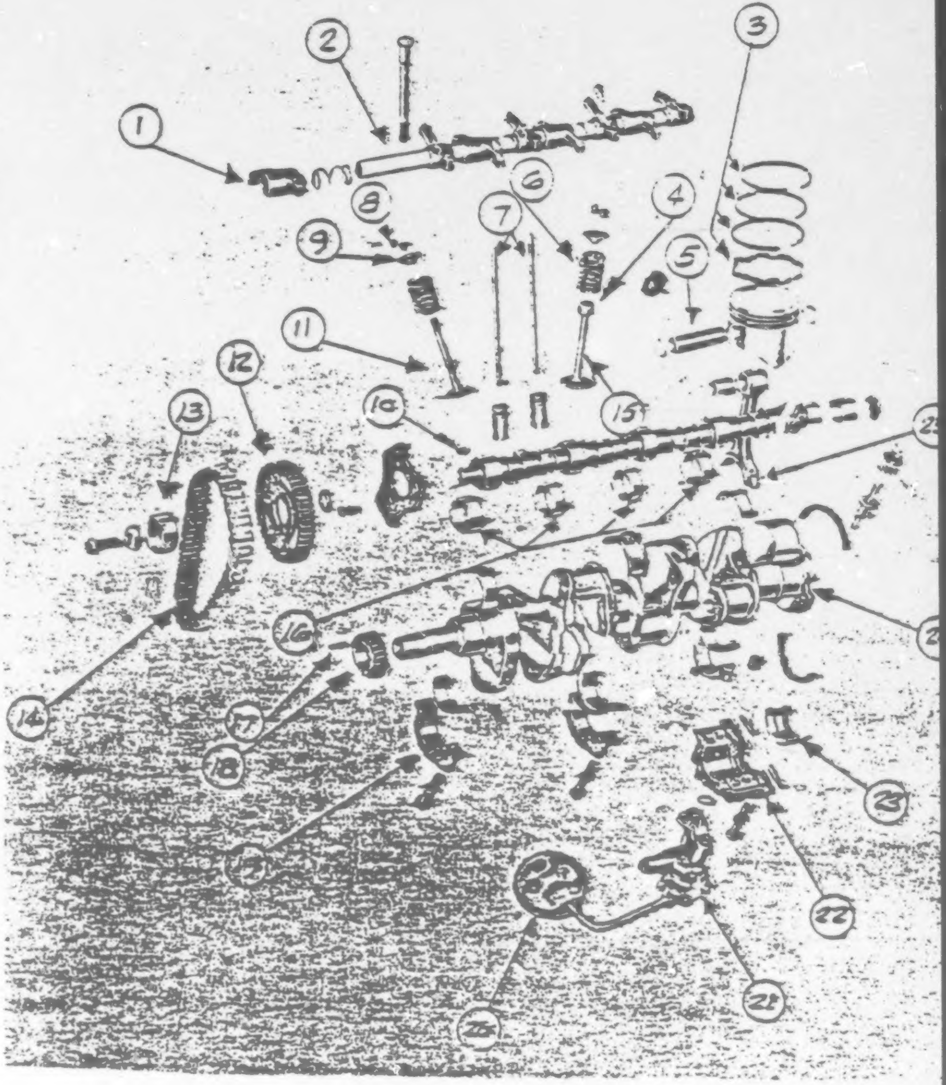


1
55
54
53
3
2
52
51
4
50
49
48
47
46
45
6
5
7
12
11
8
9
13
10
44
43
14
15
16
17
42
41
40
39
38
18
37
36
19
20
21
35
34
33
23
32
24
25
31
26
30
27
28

1 – Hose
2 – Clamp
3 – Gasket
4 – ____________
5 – Gasket
6 – ____________
7 – ____________
8 – Silencer Package
9 – Hose
10 – Cable Set
11 – Grommet
12 – ____________
13 – Grommet
14 – Valve
15 – Cover
16 – Cap
17 – Switch
18 – Gasket
19 – Plug
20 – Shield
21 – Head
23 – ____________
24 – Spark Plug
25 – Pump
26 – Gasket
27 – Pan
28 – Plug
29 – Gasket
30 – Filter
31 – Strainer w/Pipe
32 – ____________
33 – Tube
34 – Clamp
35 – Gasket
36 – Indicator
37 – ____________
38 – Shield
39 – Gasket
40 – Gasket
41 – Lead
42 – ____________
43 – Cover
44 – Reinforcement
45 – Heater
46 – Gasket
47 – Tube
48 – Cable
49 – Bracket
50 – Bracket
51 – Coil
52 – Hose
53 – ____________
54 – ____________
55 – Sensor

2. Properly name the labeled engine components pictured below.

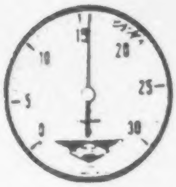
1. __________
2. __________
3. __________
4. __________
5. __________
6. __________
7. __________
8. __________
9. __________
10. __________
11. __________
12. __________
13. __________
14. __________
15. __________
16. __________
17. __________
18. __________
19. __________
20. __________
21. __________
22. __________
23. __________
24. __________
25. __________


2
3
1
6
4
8
7
9
5
11
12
13
10
15
14
16
17
18
19
20
21
22
23

## Unit 3.0 - Automotive Engine Maintenance, Repair, and Overhaul (Con't.)

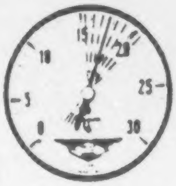
### PERFORMANCE

a. Diagnose the four engine conditions using only the given vacuum gauge readings. Assume that the vacuum gauge is correctly connected to the automobile, that the engine is idling properly at 400-500 RPM, etc. Findings must be in agreement with standard vacuum gauge interpretation and findings of instructor.



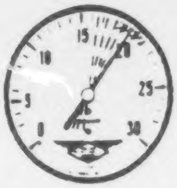
Reading: A

Low and steady



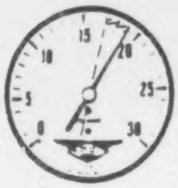
Reading: B

Rapid vibration when engine accelerated



Reading: C

Intermittent drop of needle, about four inches



Reading: C

Floating motion of needle, over range of four to five inches

Select one or more possible problems from the following and indicate by placing the number in the blanks below.

1. Low compression
2. Air leaks
3. Late ignition timing
4. Weak valve springs
5. Sticky valves
6. Faulty carburetor adjustment, probably rich mixture

Possible Problems

____________  ____________  ____________  ____________

b. You have identified a possible engine problem through using the vacuum gauge and obtaining one of the above vacuum gauge readings.

You decide to test your diagnosis by injecting penetrating oil into the intake manifold. If the unusual vacuum reading stops temporary, you can be sure the diagnosis is correct. Which vacuum gauge reading (A, B, C, D) did you obtain?

Reading = ______________

NAME ____________________

DATE ____________________

# COMPRESSION SYSTEM TESTING WORKSHEET

Eng. No. ____________________ Make/Year ________________

**AREA TESTS** Tests to quickly determine an engine's condition.

| | GOOD | BAD |
|---|---|---|
| CRANKING VACUUM<br>(Steady reading) | ☐ | ☐ |
| PCV TEST<br>(Increase in cranking vacuum with PCV pinched) | ☐ | ☐ |
| IDLE VACUUM<br>(Steady vacuum, 15" to 22") ____________________" | ☐ | ☐ |
| EXHAUST RESTRICTION<br>(Vacuum increases at higher RPM) | ☐ | ☐ |
| CYLINDER BALANCE<br>(Less than 30 RPM difference) | ☐ | ☐ |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Cylinder # | | | | | | | | |
| RPM | | | | | | | | |

RPM at start ____________________

RPM at end ____________________

(no change in RPM) ____________________

**DETAIL TESTS** Tests to pinpoint the problem.

| | | |
|---|---|---|
| COMPRESSION<br>(Within specifications) | ☐ | ☐ |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Cylinder # | | | | | | | | |
| PSI | | | | | | | | |

Specifications (from card):

____________ PSI

____________ Variation

| | | |
|---|---|---|
| CYLINDER LEAKAGE<br>No leakage at valves or head gasket, less than 20% leakage | ☐ | ☐ |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Cylinder # | | | | | | | | |
| % Leakage | | | | | | | | |

Indicate location of leakage: I - intake valve E - exhaust valve H - head or head gasket R - piston rings

Unit 3.0 - Automotive Engine Maintenance, Repair, and Overhaul

Answer Sheet

Identify

1. 4. carburetor
   6. choke
   7. manifold
   12. oil cleaner
   23. manifold
   32. block
   37. head
   42. distributor
   53. hose
   54. air cleaner

2. 1.
   2.
   3.
   4.
   5.
   6.
   7.
   8.
   9.
   10.
   11.
   12.
   13.
   14.
   15.
   16.
   17.
   18.
   19.
   20.
   21.
   22.
   23.
   24.
   25.

Performance

a. Reading A: 1, 2, 3
   Reading B: 4
   Reading C: 5
   Reading D: 6

b. Reading C: valves are sticking

## UNIT 4.0 - FUEL SYSTEM MAINTENANCE AND REPAIR

## OUTCOME-REFERENCED TESTS

Task 4.02

IDENTIFY

This explored view of the Carter RBS shows most of the parts of the carburetor. Identify those parts marked with numbers and not labeled.

a. ____________________

b. ____________________

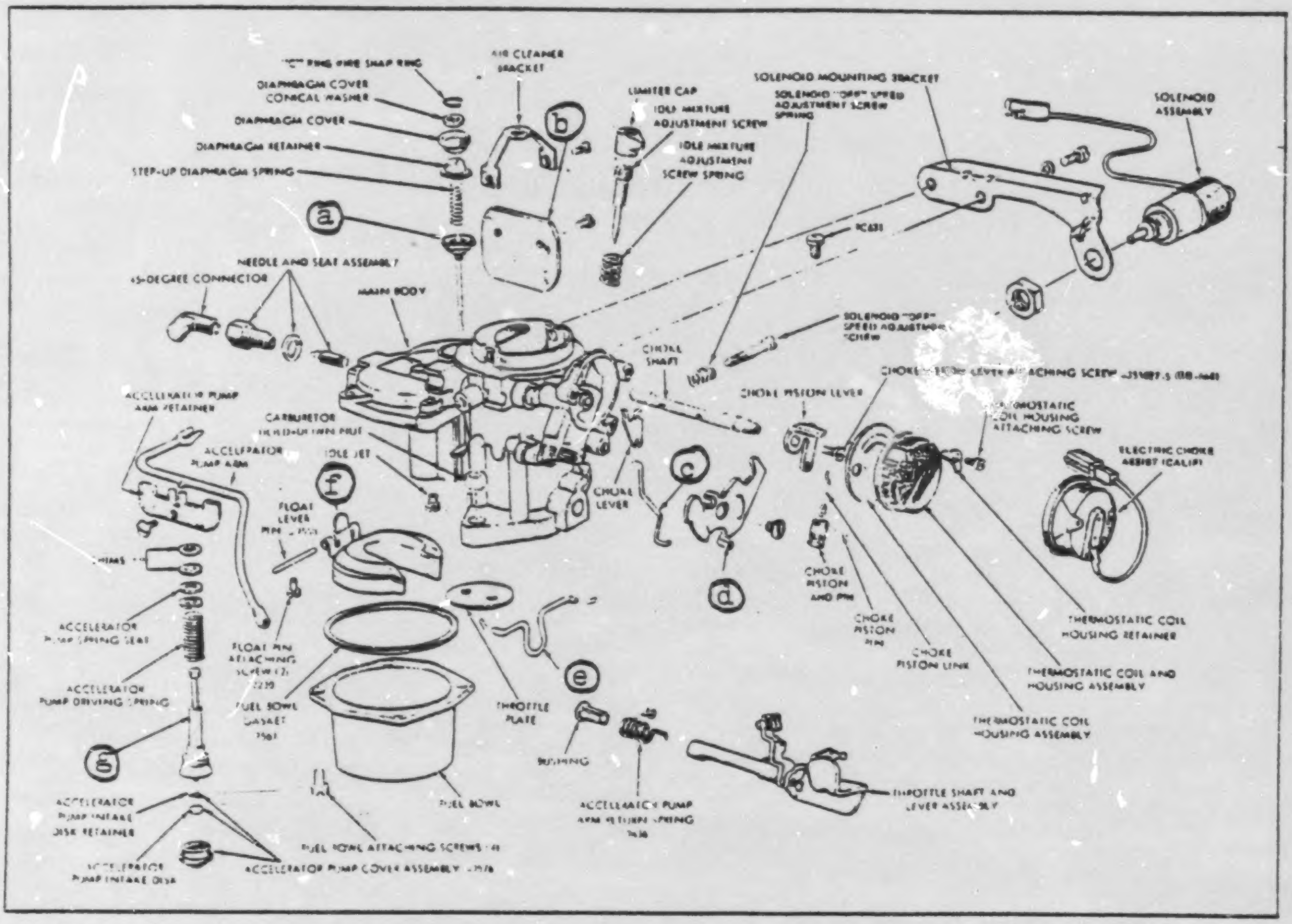
c. ____________________

d. ____________________

e. ____________________

f. ____________________

g. ____________________


"C" RING WIRE SNAP RING
DIAPHRAGM COVER CONICAL WASHER
DIAPHRAGM COVER
DIAPHRAGM RETAINER
STEP-UP DIAPHRAGM SPRING
a
AIR CLEANER BRACKET
b
LIMITER CAP
IDLE MIXTURE ADJUSTMENT SCREW
IDLE MIXTURE ADJUSTMENT SCREW SPRING
SOLENOID MOUNTING BRACKET
SOLENOID "OFF" SPEED ADJUSTMENT SCREW SPRING
SOLENOID ASSEMBLY
NEEDLE AND SEAT ASSEMBLY
45-DEGREE CONNECTOR
MAIN BODY
SOLENOID "OFF" SPEED ADJUSTMENT SCREW
CHOKE SHAFT
CHOKE PISTON LEVER ATTACHING SCREW
CHOKE PISTON LEVER
THERMOSTATIC COIL HOUSING ATTACHING SCREW
ELECTRIC CHOKE ASSIST (CALIF)
ACCELERATOR PUMP ARM RETAINER
CARBURETOR HOLD-DOWN PIN PILE
ACCELERATOR PUMP ARM
IDLE JET
f
FLOAT LEVER PIN
CHOKE LEVER
c
d
CHOKE PISTON AND PIN
CHOKE PISTON PIN
CHOKE PISTON LINK
THERMOSTATIC COIL HOUSING RETAINER
THERMOSTATIC COIL AND HOUSING ASSEMBLY
THERMOSTATIC COIL HOUSING ASSEMBLY
SHIMS
ACCELERATOR PUMP SPRING SEAT
ACCELERATOR PUMP DRIVING SPRING
FLOAT PIN ATTACHING SCREW (2)
FUEL BOWL GASKET
THROTTLE PLATE
e
g
BUSHING
FUEL BOWL
ACCELERATOR PUMP ARM RETURN SPRING
THROTTLE SHAFT AND LEVER ASSEMBLY
ACCELERATOR PUMP INTAKE DISK RETAINER
ACCELERATOR PUMP INTAKE DISK
FUEL BOWL ATTACHING SCREWS (4)
ACCELERATOR PUMP COVER ASSEMBLY

# UNIT 4.0 - FUEL SYSTEM MAINTENANCE AND REPAIR

## OUTCOME-REFERENCED TESTS

### TASK 4.03 - PERFORMANCE

On a vehicle provided, using given tools, equipment, and service data; adjust the carburetor to manufacturer's specifications by following the recommended procedures. Idle set must be within +/- 50 RPM's of the manufacturer's specifications. Tachometer must be correctly connected the first time and properly used. The performance steps and the service vehicle must meet the instructor's standards.

### TASK 4.05 - PERFORMANCE

On a given vehicle, using tools, equipment, service manual and parts as necessary supplied by the instructor; remove and install or replace a carburetor on a given vehicle. The manufacturer's removal and replacement procedures must be followed 100 percent. Idle speed must be set within +/- 50 RPM's of manufacturer's specifications. The job must be accomplished within less than twice the flat rate manual time. Performance must meet the instructor's standards.

### TASK 4.06

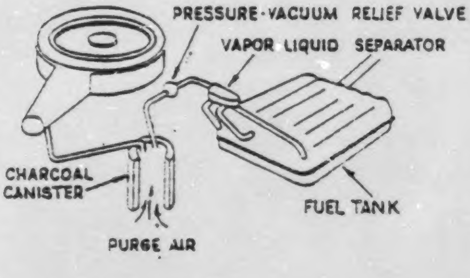
A student finds liquid gas in the charcoal canister in the system shown below:

Student "A" says, the pressure-vacuum valve is installed backwards.

Student "B" says, this is a normal condition.

Who is right?

___ a. Student "A" only
b. Student "B" only
c. both student "A" or "B"
d. neither student "A" nor "B"

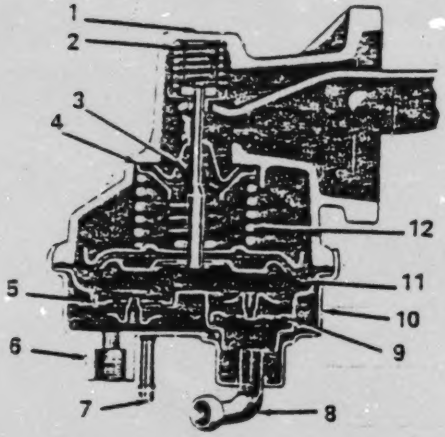


## OUTCOME-REFERENCED TESTS

### TASK 4.08

Identify the parts of the FUEL PUMP using the spaces provided.

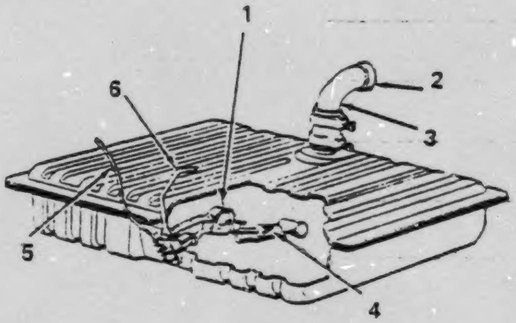
1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________
11. ____________________
12. ____________________



### TASK 4.10

Identify the parts of a FUEL TANK using the spaces provided.

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________



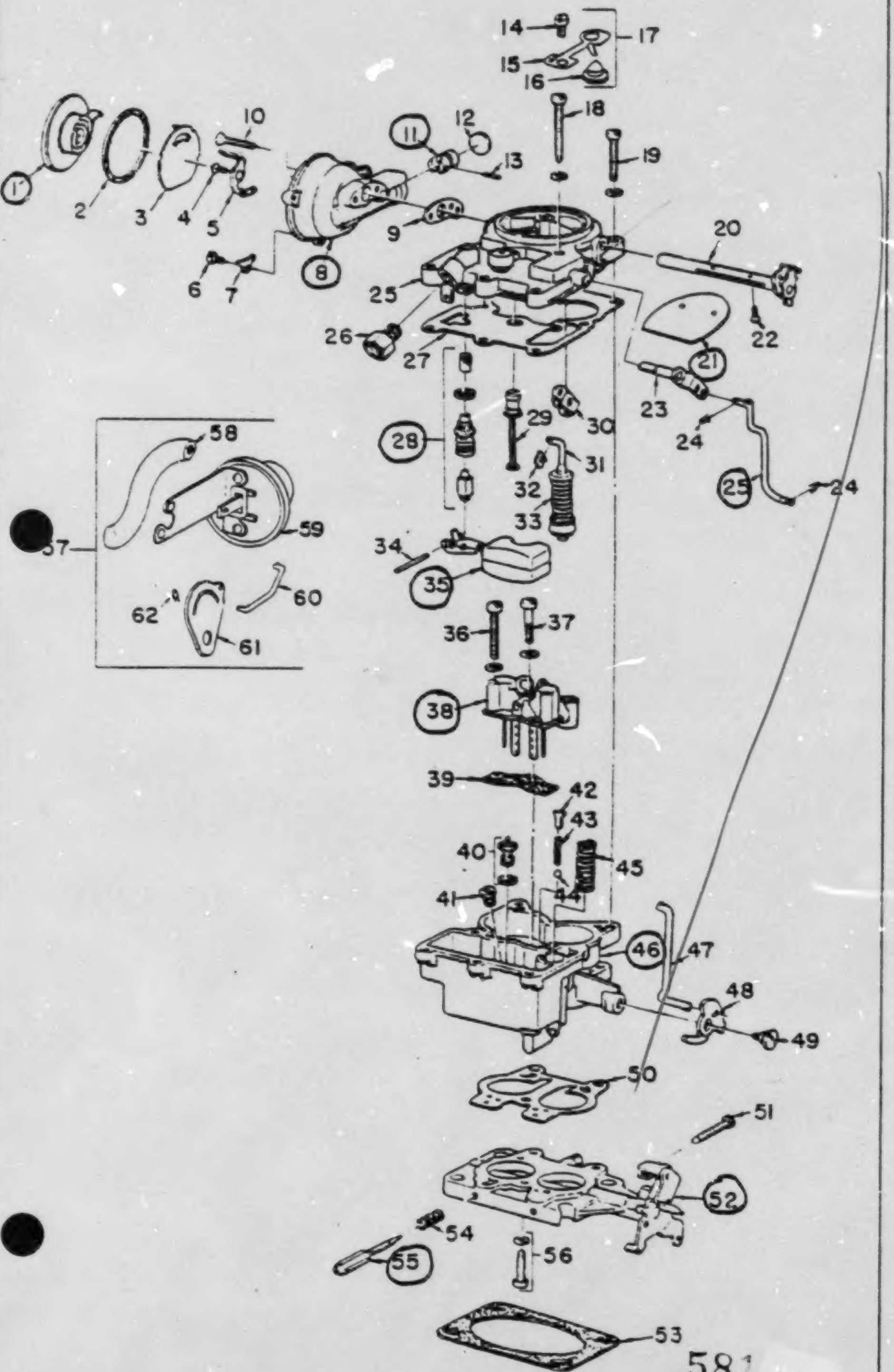
# UNIT 4.0 - FUEL SYSTEM MAINTENANCE AND REPAIR

## OUTCOME-REFERENCED TESTS

TASK 4.13

On the following drawing of a carburetor, properly name the labeled parts.

**TYPICAL EXPLODED VIEW—MODELS 2G, 2GC, 2GV**



**PARTS**

1. ________
2. Gasket - choke cover and coil.
3. Choke baffle plate.
4. Screw - choke piston lever.
5. Choke piston lever and link assembly.
6. Screw - choke cover attaching.
7. Retainers - choke cover.
8. ________
9. Gasket - Choke housing.
10. Screw - Choke housing attaching.
11. ________
12. Plug - Choke housing.
13. Pin - Choke piston.
14. Screw - Idle vent valve attaching.
15. Idle vent valve holder.
16. Idle vent valve.
17. Idle vent valve assembly.
18. Screw - Air horn attaching (long).
19. Screw - Air horn attaching (short).
20. Choke shaft and lever assembly.
21. ________
22. Screw - choke valve attaching.
23. Pump shaft and lever assy.
24. Clips - pump rod attaching,
25. ________
26. Fitting - fuel inlet.
27. Gasket - air horn.
28. ________
29. Power piston assembly
30. Inner pump lever.
31. Pump plunger assembly.
32. Clip - pump plunger.
33. Spring - pump duration.
34. Float hinge pin.
35. ________
36. Screw - Cluster attaching (outside).
37. Screw - Cluster attaching (center).
38. ________
39. Gasket - Venturi cluster.
40. Power valve and gasket assembly.
41. Main Metering Jet.
42. Retainer - Pump discharge spring.
43. Spring - Pump discharge.
44. Ball - Pump discharge (steel).
45. Spring - pump return.
46. ________
47. Choke rod.
48. Fast idle cam.
49. Screw - Fast idle cam attaching.
50. Gasket - Throttle body to bowl.
51. Screw - Idle speed.
52. ________
53. Gasket - carburetor to manifold.
54. Spring - Idle mixture needle.
55. ________
56. Screw & Lockwasher - Throttle Body attaching.
57. Choke - Vacuum diaphragm assembly.
58. Hose - Choke vacuum diaphragm.
59. Choke vacuum diaphragm assembly.
60. Link - Vacuum diaphragm to choke lever.
61. Lever - Choke shaft lever.
62. Clip - Vacuum diaphragm link.

Unit 4.0 - Fuel System Maintenance and Repair

Answer Sheet

Task 4.02

a. step up rod and diaphragm assembly

b. choke valve

c. fast idle connecting rod

d. fast idle cam

e. accelerator pump

f. float assembly

g. accelerator pump plunger

Task 4.06

Task 4.08

1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.

Task 4.10

1.
2.
3.
4.
5.
6.

## Unit 4.0 - Fuel System Maintenance and Repair (Con't.)

### Task 4.13

1. choke cover and coil assembly

8. choke housing assembly

11. choke piston

21. choke valve

25. pump rod

28. needle and seat assembly

35. float assembly

38. venturi cluster assembly

46. float bowl assembly

52. throttle body assembly

55. screw - idle mixture

# UNIT 6.0 A - COOLING SYSTEM MAINTENANCE AND REPAIR

## OUTCOME-REFERENCED TESTS

TRUE/FALSE

1. ___ Overheating causes loss of coolant.
2. ___ Overcooling an engine is as bad as overheating
3. ___ Poor fuel mileage is a result of overheating.
4. ___ The circulation of coolant stops during overcooling.
5. ___ The forced circulation system is the most common air cooling system.
6. ___ An air-cooled engine is generally heavier than a liquid-cooled one.
7. ___ Coolant passages in the block are called water jackets.
8. ___ The coolant pump is usually driven by gears.
9. ___ The heat exchanger is located in the radiator.
10. ___ The fan blows air over the engine to cool it.
11. ___ A temperature light indicated overheating.
12. ___ An engine "pings" when it is overcooled.
13. ___ Coolant may be lost inside the engine.
14. ___ Coolant leaks may be found with a pressure tester.
15. ___ Poor coolant flow may be caused by a bad fan belt.
16. ___ A restriction in the radiator may cause overcooling.
17. ___ Scale build-up in the water jackets may cause poor heat flow.
18. ___ The main reason for overcooling is a defective or missing thermostat.
19. ___ A malfunction in a fan clutch can cause poor air flow.
20. ___ Poor air flow can be caused by a slipping fan belt.

MULTIPLE CHOICE

1. Which of the following type(s) of cooling system is/are used today:

___ a. liquid
b. air
c. both a and b
d. neither a nor b

2. Which of the following is/are caused by overcooling:

___ a. poor fuel mileage
b. high emissions
c. oil dilution
d. all of the above

3. When the engine is cold, coolant flows:

___ a. into the bottom radiator tank
b. through the heat exchanger
c. only through the block
d. none of the above

4. A vacuum is prevented in the radiator by the:

___ a. pressure cap
b. coolant recovery system
c. thermostat
d. none of the above

5. Which of the following is/are a type of fan:

___ a. flex
b. fixed blade
c. clutch
d. all of the above

6. Coolant may be lost:

___ a. inside the engine
b. outside the engine
c. both a and b
d. neither a nor b

7. Overheating may be caused by:

___ a. poor heat flow
b. poor coolant flow
c. poor air flow
d. all of the above

8. Poor air flow may be caused by:

___ a. clogged radiator fins
b. a slipping fan belt
c. a defective fan clutch
d. all of the above

9. Poor heat flow may be corrected by:

___ a. flushing
b. hydrometer
c. reverse flushing
d. all of the above

10. The coolant strength may be determined with a:

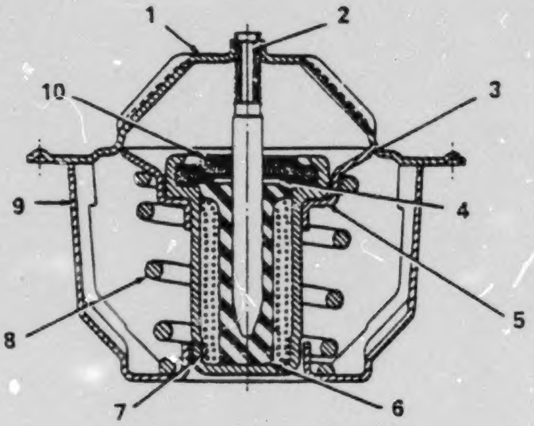
___ a. pump
b. hydrometer
c. pressure tester
d. all of the above

## OUTCOME-REFERENCED TESTS

### TASK 6.04

Identify the parts of the THERMOSTAT in the spaces provided.

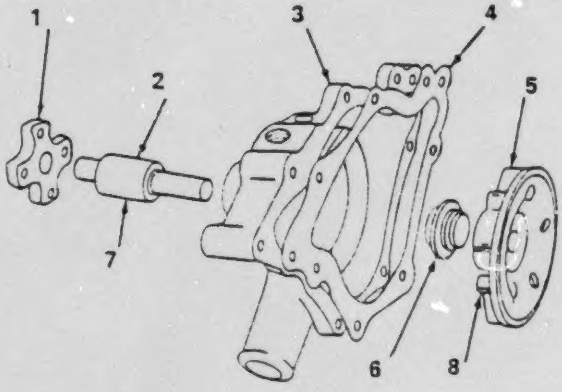
1. ____________
2. ____________
3. ____________
4. ____________
5. ____________
6. ____________
7. ____________
8. ____________
9. ____________
10. ____________



### TASK 6.12

Identify the part of the COOLANT PUMP in the spaces provided.

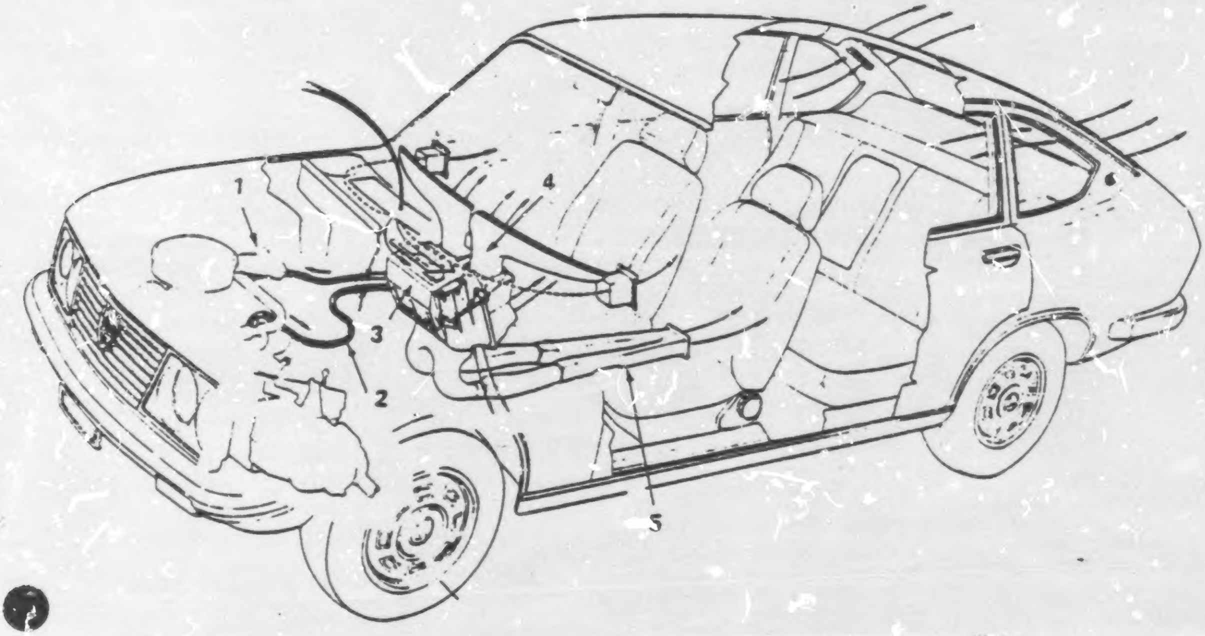
1. ____________
2. ____________
3. ____________
4. ____________
5. ____________
6. ____________
7. ____________
8. ____________



## UNIT 6.0 B - AUTOMOBILE HEATER MAINTENANCE AND REPAIR

## OUTCOME-REFERENCED TESTS

Identify the main components of the heating system in the spaces provided.



1. ______________________________ 4. ______________________________

2. ______________________________ 5. ______________________________

3. ______________________________

In the spaces provided describe the purpose of each part listed below.

Blower ____________________________________________________________

___________________________________________________________________

Heater Core _______________________________________________________

___________________________________________________________________

## Unit 6.0 B - Automotive Heater Maintenance and Repair (Con't.)

### TRUE/FALSE

1. ___ The heater assembly is designed to heat the inside of the car.
2. ___ Hot coolant from the radiator is routed to the heater core.
3. ___ Air is directed over the heater core to warm the air inside the car.
4. ___ The only job of the air conditioner is to cool the air.
5. ___ Refrigeration systems cool by evaporation.
6. ___ The substance that carries heat away is called refrigerant.
7. ___ The refrigerant used in most automotive air conditioners is called R-12.
8. ___ The moisture content in the air is its humidity.
9. ___ A refrigerant boils at a very high temperature.
10. ___ The refrigeration cycle describes how air conditioning works.

### MULTIPLE CHOICE

1. The heat in a heater sytem comes from:

   ___ a. outside air
   b. exhause manifold
   c. radiator coolant
   d. none of the above

2. Air is directed over the heater core by the:

   ___ a. engine fan
   b. compressor
   c. blower
   d. none of the above

3. Refrigerant is circulated by the:

   ___ a. evaporator
   b. compressor
   c. blower
   d. none of the above

4. The heat exchanger in the air conditioner is called the:

___ a. evaporator
b. compressor
c. heater core
d. none of the above

5. Refrigerant flow is controlled by the:

___ a. condenser
b. evaporator
c. expansion valve
d. none of the above

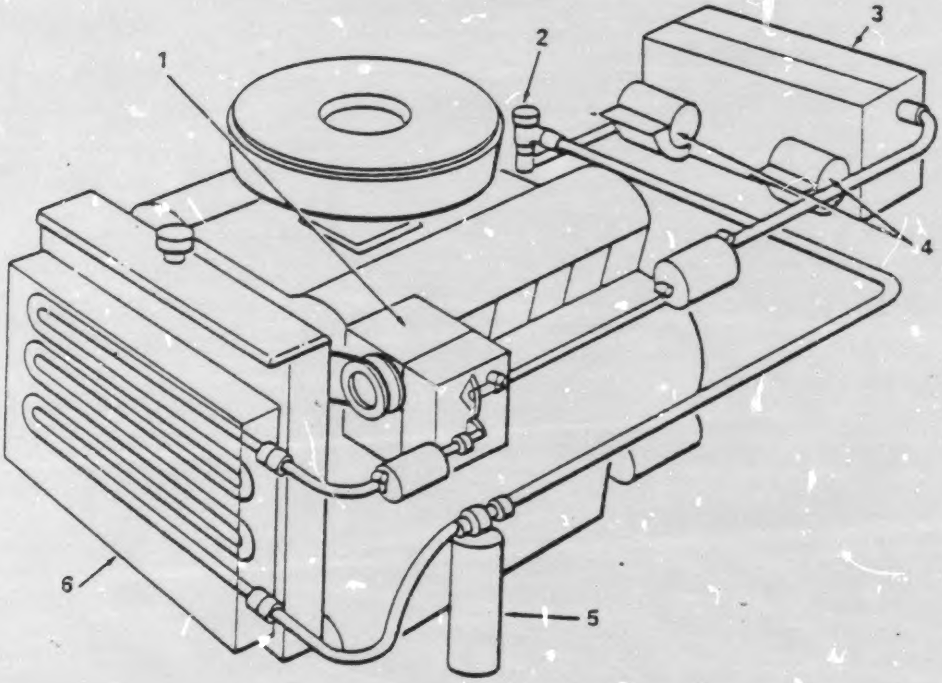
TASK 6.05 - PERFORMANCE

On an automobile provided by the instructor, using furnished tools, equipment, and service information; performance test the heating system and diagnose malfunctions. The problems identified must agree 100 percent with the instructor's findings. The instructor's standards must be met. The task must be accomplished in one hour.

# UNIT 6.0 C - AUTOMOTIVE AIR CONDITIONER MAINTENANCE AND REPAIR

## OUTCOME-REFERENCED TESTS

Identify the parts of an AIR CONDITIONING SYSTEM in the spaces provided below.



1. ____________________

2. ____________________

3. ____________________

4. ____________________

5. ____________________

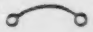
6. ____________________

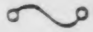
## UNIT 7.0 - ELECTRICAL AND IGNITION SYSTEMS

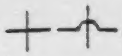
## OUTCOME-REFERENCED TESTS

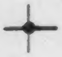
### MATCHING

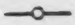
Match the terms on the right with the drawings on the left.

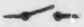
1.  ______

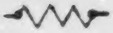
2.  ______

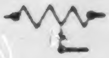
3.  ______

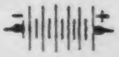
4.  ______

5.  ______

6.  ______

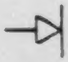
7.  ______

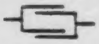
8.  ______

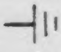
9.  ______

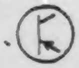
10. ______

11. ______

12.  ______

13.  ______

14.  ______

15.  ______

A. Resistor.

B. Circuit Breaker.

C. Wires Crossing - Not Connected.

D. Fuse.

E. Diode.

F. Wires Crossing - Connected.

G. Positive.

H. Terminal.

I. Switch.

J. Rheostat.

K. Transistor.

L. Battery.

M. Negative.

N. Condenser.

O. Ground.

# UNIT 7.0 - ELECTRICAL AND IGNITION SYSTEMS

## OUTCOME-REFERENCED TESTS

TASK 7.01 - 7.03

Identify the components marked on the following drawing.

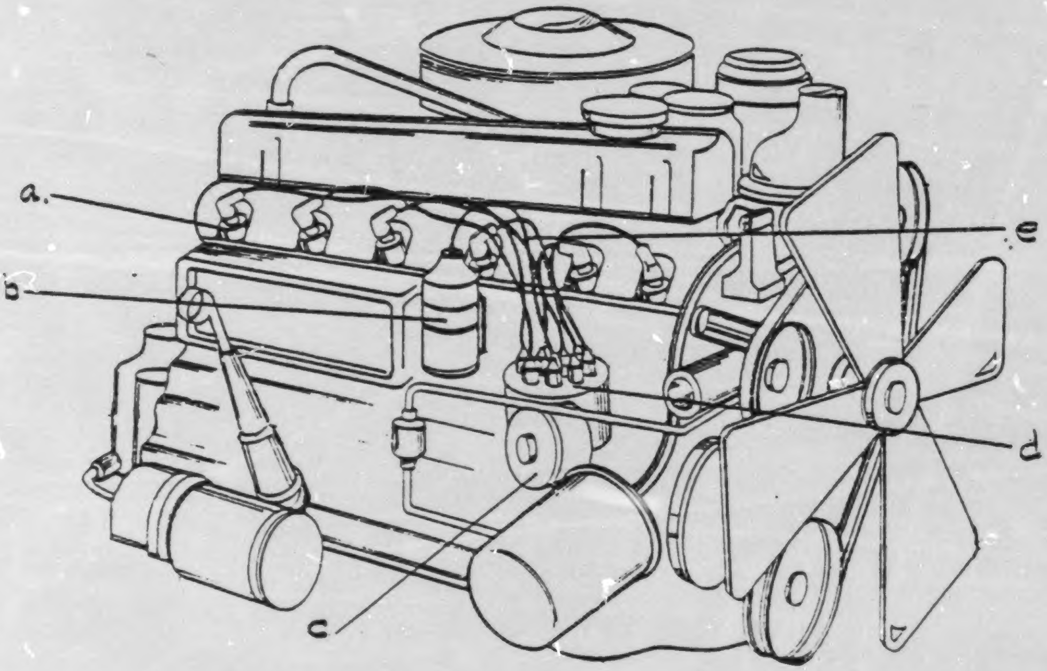
a. ____________________

b. ____________________

c. ____________________

d. ____________________

e. ____________________



# UNIT 7.0 - ELECTRICAL AND IGNITION SYSTEMS

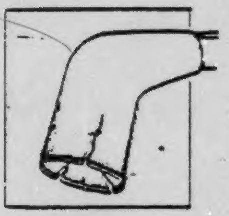
## OUTCOME-REFERENCED TESTS

### MATCHING

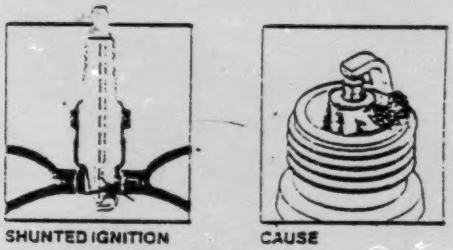
You are checking the spark plugs and spark plug wires on a given automobile because the owner reports a skip.

Match the best description on the right with the drawing on the left.

1. ___



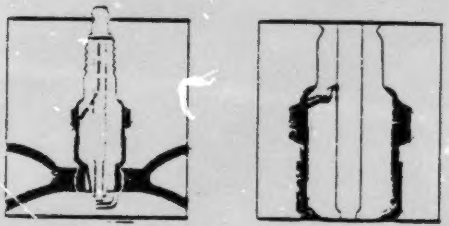
2. ___



SHUNTED IGNITION CAUSE

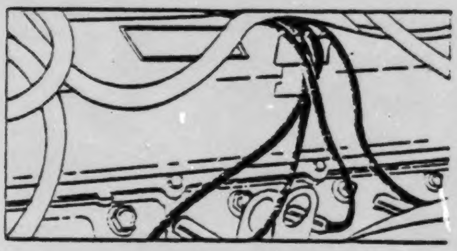
Spark jumps from one deposit to another. Fuel ignites, but timing is retarded.

3. ___



Crack in spark plug insulator short circuits voltage to ground.

4. ___

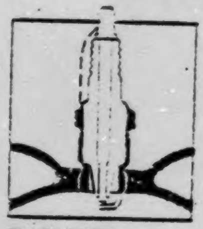


a. Electrodes bent or so badly eroded available voltage is insufficient to jump across it.

b. Procedure - Determine the cause. Correct the condition before replacing the plug.

c. Procedure - Replace spark plug.

d.



FLASHOVER

e. Detonation or pre-ignition.

f. Replace all spark plug wires.

g. Bad Fuel.

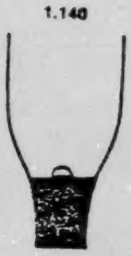
## UNIT 7.0 - ELECTRICAL AND IGNITION SYSTEMS

## OUTCOME-REFERENCED TESTS

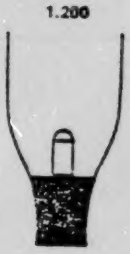
TASK 7.05

You have taken a specific gravity reading of given batteries. Interpret the following readings.

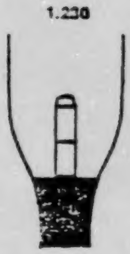
1. ___



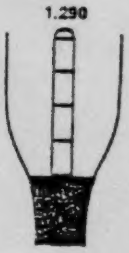
2. ___



3. ___



4. ___



a. Charged

b. 3/4 Charged

c. 1/2 Charged

d. 1/4 Charged

e. About to fail

f. No charge

g. Plates and separators in bad condition

h. Good condition

## UNIT 7.0 - ELECTRICAL AND IGNITION SYSTEMS

## OUTCOME-REFERENCED TESTS

TASK 7.11

PERFORMANCE

Using a given timing light and engine, hook up and use an ignition timing light to locate the timing marks for a vehicle and check the timing against given specifications. Your findings must be 100 percent accurate and agree with the findings of the instructor.

Student ______________________________ Date ______________

Section ______________________________ Instructor's Check __________

PERFORMANCE JOB SHEET - ADJUST IGNITION TIMING

Make of Car ________________ Model ______________ Year ________

Time Started ________ Time Finished __________ Total Time __________

Flat Rate Time ______________________________________________

## Special Tools, Equipment, Parts, and Materials

Timing light ________________________

Tachometer ________________________

________________________ ________________________

________________________ ________________________

________________________ ________________________

## References

Manufacturer's Shop Manual ______________________________

Repair Manual ______________________________

Service Bulletin ______________________________

## Specifications

Look up the following specifications and write it in the space provided below.

Ignition timing dimension ______________________________

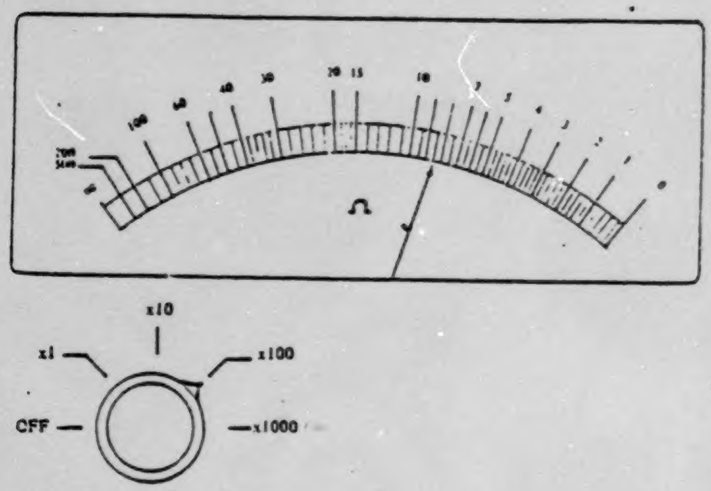
## UNIT 7.0 - ELECTRICAL AND IGNITION SYSTEMS

## OUTCOME-REFERENCED TESTS

TASK 7.18

1. The below meter reading is:

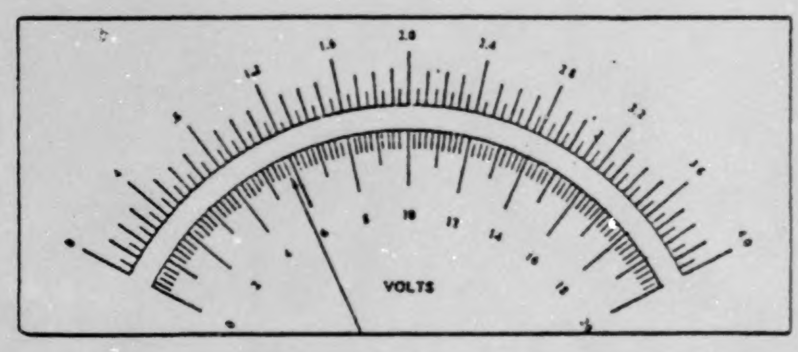
   ___ a. 8.5 ohms
   b. 85 ohms
   c. 850 ohms
   d. 8,500 ohms

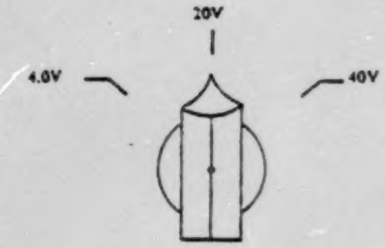


Ω
x10
x1
x100
OFF
x1000

2. The below meter reading is:

   ___ a. 4.9 volts
   b. 5.08 volts
   c. 5.4 volts
   d. 5.8 volts





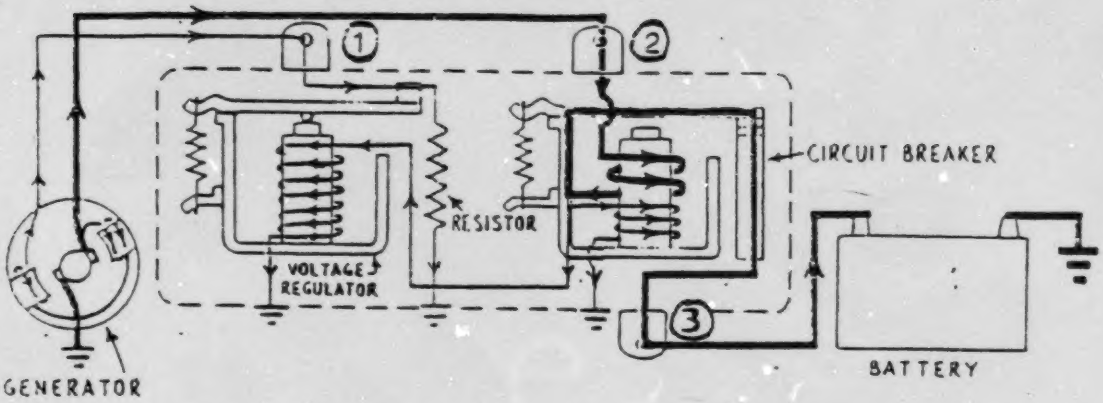
TASK 7.26

On the following drawing, identify the correct field, armature, and battery terminals.

1. ____________________ a. battery

2. ____________________ b. armature

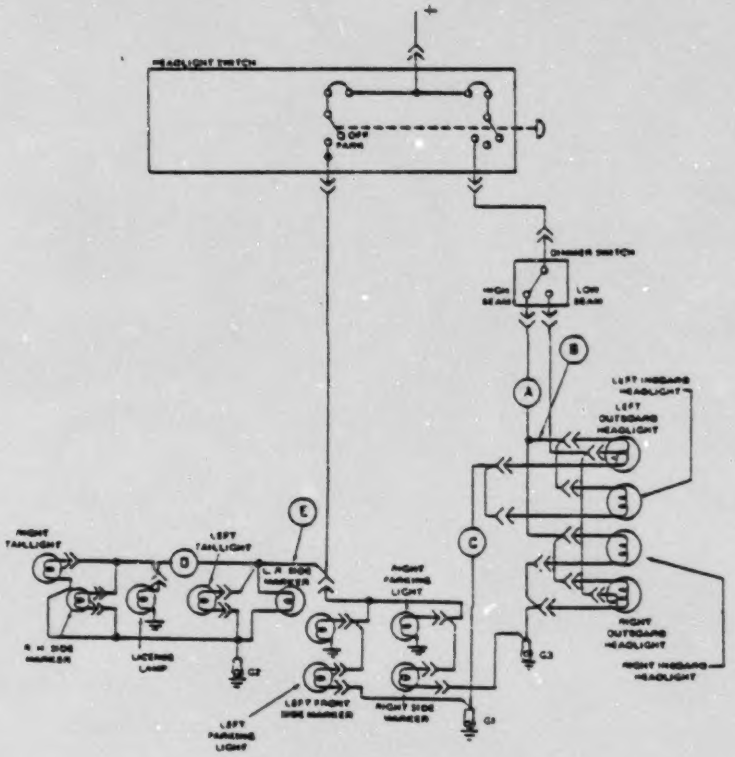
3. ____________________ c. field


①
②
CIRCUIT BREAKER
RESISTOR
VOLTAGE REGULATOR
③
BATTERY
GENERATOR

## UNIT 7.0 - ELECTRICAL AND IGNITION SYSTEMS

## OUTCOME-REFERENCED TESTS

TASK 7.23


+
HEADLIGHT SWITCH
OFF
PARK
DIMMER SWITCH
HIGH BEAM
LOW BEAM
B
A
LEFT INBOARD HEADLIGHT
LEFT OUTBOARD HEADLIGHT
E
C
RIGHT TAILLIGHT
D
LEFT TAILLIGHT
L R SIDE MARKER
RIGHT PARKING LIGHT
R H SIDE MARKER
LICENSE LAMP
G2
G3
RIGHT OUTBOARD HEADLIGHT
RIGHT INBOARD HEADLIGHT
LEFT FRONT SIDE MARKER
RIGHT SIDE MARKER
G4
LEFT PARKING LIGHT

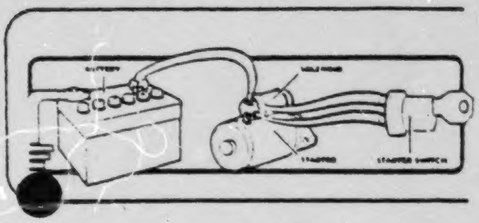
1. If the tail lights and rear side marker lights fail to operate in the above circuit, but the license plate light does, the MOST LIKELY cause is:

____ a. wire E open
b. wire D open
c. ground wire G2 missing
d. ground wire G4 missing

2. Refer to the circuit diagram for question 1. The left inboard and left outboard high beam filaments do not work. Both right side high beam filaments operate. Both low beams are okay. What could be wrong?

____ a. wire A open
b. wire B open
c. wire C open
d. ground wire G3 missing

TASK 7.25



# SUN VAT-40/28

## STARTING AND CHARGING SYSTEM TEST REPORT

BATTERY
ALTERNATOR
REGULATOR

Customer Name ______ Phone ______ Date ______

Address ______ City/State ______ License ______

Make/Year/Model ______ Mileage ______ Mileage Since Tune-Up ______

Engine ______ Transmission — Auto ☐ Std ☐ Air Conditioning Yes ☐ No ☐

Carburetor ______ Ign. Type ______ Battery Age ______

Reason For Tests ______ Tested By ______

| VISUAL INSPECTION | COMMENTS | GO | NO GO |
|---|---|---|---|
| BATTERY CASE/HOLDDOWN | | | |
| WATER LEVEL/SPECIFIC GRAVITY | | | |
| CABLES AND TERMINALS | | | |
| ALTERNATOR/ACCESSORY BELTS | | | |
| ALTERNATOR AND REGULATOR WIRING | | | |

| BATTERY RATING CHECK | READ | BATTERY SPECIFIED FOR VEHICLE | BATTERY IN VEHICLE | GO | NO GO |
|---|---|---|---|---|---|
| AMPERE HOUR RATING (20 HOUR) | SPEC. CARD | | | | |
| COLD CRANKING AMPS AT 0° F. | SPEC. CARD | | | | |

### STARTING AND CHARGING SYSTEM TESTS

| TEST MODE | TESTS | READ | ENTER SPECIFICATIONS | TEST RESULT | GO | NO GO |
|---|---|---|---|---|---|---|
| #1 BATTERY AND STARTING SYSTEM | BATTERY LOAD | AMMETER | | | | |
| | LOAD VOLTAGE | VOLTMETER | | | | |
| | STARTER CURRENT | AMMETER | | | | |
| | CRANKING VOLTAGE | VOLTMETER | | | | |
| #2 CHARGING SYSTEM | ALTERNATOR (GENERATOR) OUTPUT | AMMETER | | | | |
| #2A (IF #2 IS NO GO) CHARGING SYSTEM WITH FIELD JUMPER | ALTERNATOR (GENERATOR) OUTPUT WITH VOLTAGE REGULATOR BYPASSED | AMMETER | | | | |
| #3 VOLTAGE REGULATOR | VOLTAGE REGULATION | VOLTMETER | | | | |
| #4 DIODE-STATOR | DIODES AND STATOR CONDITION | D/S SCALE | OK BAND | | | |
| #5 BATTERY DRAIN | SHORTS IN ELECTRICAL SYSTEM | AMMETER | ZERO | | | |

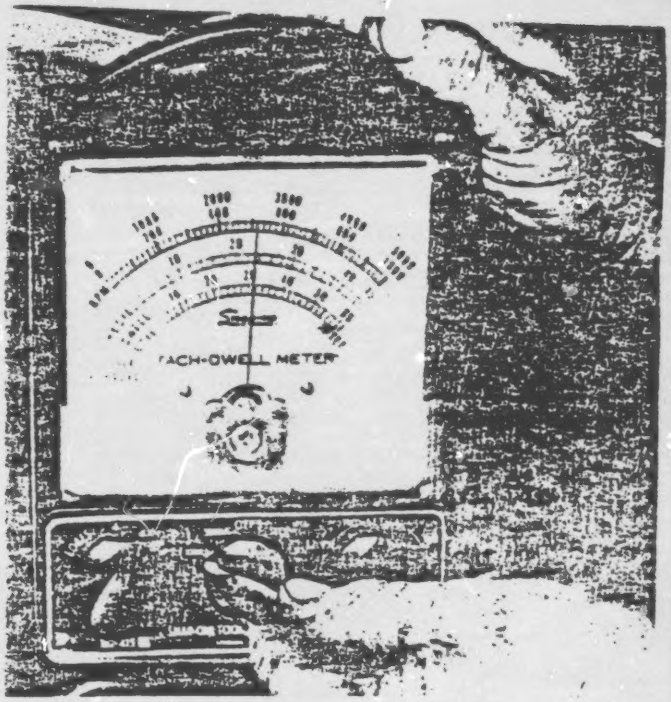
## UNIT 7.0 - ELECTRICAL AND IGNITION SYSTEMS

## OUTCOME-REFERENCED TESTS

### TASK 7.27

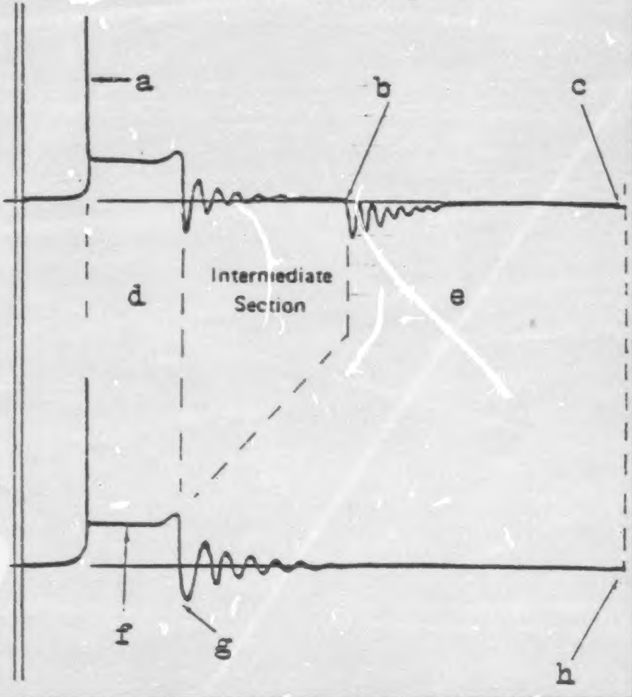
1. The RPM reading in this picture of a dual range tachometer is:

____ a. about 500 RPM
b. about 1500 RPM
c. about 2600 RPM
d. none of the above



2. On the given conventional ignition-system waveform at the top and an electronic ignition system waveform at the bottom, identify the following:

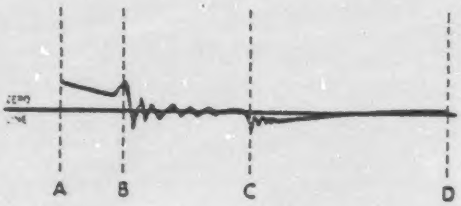
1. ____ transistor turns on
2. ____ points open
3. ____ firing line
4. ____ transistor shuts off
5. ____ points close
6. ____ spark line
7. ____ firing section
8. ____ dwell section



Task 7.27 (Con't.)

3. Which letter on the following scope pattern indicates where the points close?

____ a. at A
b. at B
c. at C
d. at D



Student ______________________________ Date ____________

Section ________________ Instructor's Check _____________

PERFORMANCE JOB SHEET - ADJUSTING DWELL

Make of Car ___________ Model ___________ Year _________

Time Started ______ Time Finished ______ Total Time ________

Flat Rate Time or Recommended Time ___________________________

Special Tools, Equipment, Parts, and Materials

Dwell ________________________

________________________ ________________________

________________________ ________________________

________________________ ________________________

________________________ ________________________

References

Manufacturer's Shop Manual __________________________________

Repair Manual ____________________________________________

Service Bulletin __________________________________________

Specifications

Look up the following specification and record it in the space provided below.

Dwell or Cam Angle _______________________________________

# SUN TUT—1015

# ENGINE PERFORMANCE TEST REPORT

Customer Name ____________________ Phone ____________ Date ____________
Address ____________________ City/State ____________ License ____________
Make/Year/Model ____________________ Mileage ____________ Mileage Since Tune-Up ____________
Engine ____________ Transmission—Auto ☐ Std ☐ Air Conditioning—Yes ☐ No ☐
Carburetor ____________ Ignition Type ____________ Air Pump—Yes ☐ No ☐ Converter—Yes ☐ No ☐
Reason For Tests ____________________ Tested By ____________

| TEST MODE | TESTS | READ | ENTER SPECIFICATIONS | | TEST RESULT | GO | NO GO |
|---|---|---|---|---|---|---|---|
| #1 CRANKING | COIL OUTPUT | SCOPE (DISPLAY) | KV (MIN) | | | | |
| | STARTER CURRENT | AMMETER | AMPS (MAX) | | | | |
| | BATTERY VOLTAGE | VOLTMETER | VOLTS (MIN) | | | | |
| | ENGINE VACUUM | VACUUM GAUGE | STEADY | | | | |
| #2 CHARGING | CHARGING SYSTEM | AMMETER | SHOWS CHARGE | ▨ | | | |
| | DIODE STATOR | SCOPE (ALT) | EVEN RIPPLE | ▨ | | | |
| #3 IDLE | RPM | TACHOMETER | RPM | | | | |
| | DWELL | DWELL METER | DEGREES | | | | |
| | INITIAL TIMING | TIMING LIGHT | DEGREES | | | | |
| | ENGINE VACUUM | VACUUM GAUGE | INCHES | | | | |
| | PCV | TACH, VACUUM GAUGE | RPM - VAC | | | | |
| #4 1200 RPM LOW CRUISE | COIL POLARITY | SCOPE (DISPLAY) | VISUAL | ▨ | | | |
| | SPARK PLUGS | SCOPE (DISPLAY) | KV | | | | |
| | MAX COIL OUTPUT | SCOPE (DISPLAY) | KV (MIN) | | | | |
| | SECONDARY INSUL. | SCOPE (DISPLAY) | VISUAL | ▨ | | | |
| | SECONDARY RESISTANCE | SCOPE (RASTER SHIFT) | VISUAL | ▨ | | | |
| | COIL, CONDENSER | SCOPE (RASTER SHIFT) | VISUAL | ▨ | | | |
| | BREAKER POINTS | SCOPE (RASTER SHIFT) | VISUAL | ▨ | | | |
| | CYLINDER TIMING | SCOPE (SUPER-CONV) | VISUAL | ▨ | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| #5 CYLINDER POWER BALANCE | ENGINE | TACHOMETER | | | | BASE RPM | | | | |
| | SHORTED RPM | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | |
| | | | | | | | | | | |

| TEST MODE | TESTS | READ | ENTER SPECIFICATIONS | | TEST RESULT | GO | NO GO |
|---|---|---|---|---|---|---|---|
| #6 SNAP ACCEL. | PLUGS UNDER LOAD | SCOPE (DISPLAY) | KV | | | | |
| #7 2500 RPM HIGH CRUISE | TIMING ADVANCE | TIMING LIGHT | DEGREES | | | | |
| | DWELL | DWELL METER | DEGREES | | | | |
| | CHARGING VOLTS | VOLTMETER | VOLTS | | | | |
| | ENGINE VACUUM | VACUUM GAUGE | INCHES | | | | |

## UNIT 7.0 - ELECTRICAL AND IGNITION SYSTEMS

## OUTCOME-REFERENCED TESTS

TASK 7.29-a

You are making a resistance check on a General Motors HEI system. Look at Figure 1.

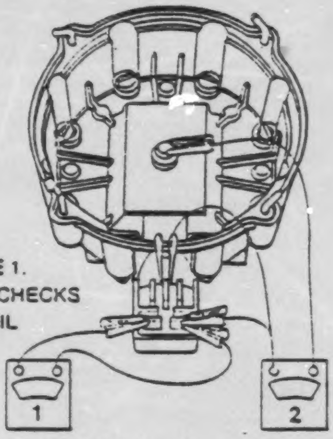


FIGURE 1.
OHMMETER CHECKS
OF COIL

1. Ohmmeter set up (1) reads .5 ohms. According to this reading, you should:

____ a. replace the coil
b. go to the next step, since the reading is correct
c. neither of the above
d. check your ohmmeter range setting

2. Ohmmeter set up (2) reads 20,000 ohms. According to this reading, you should:

____ a. remove coil from cap and check again
b. go to the next testing step, the reading is within an acceptable range
c. replace the coil
d. switch ohmmeter range setting to lower range and read the scale

3. In the ohmmeter set up (2) of Figure 1., assume that the resistance reading (ohms) indicates a problem. Answer the following true-false question:

____ A bad center button or broken spring can cause an incorrect reading.

## Task 7.29-b

You are continuing to make resistance checks on a G.M. HEI system. Look at Figure 2 below.

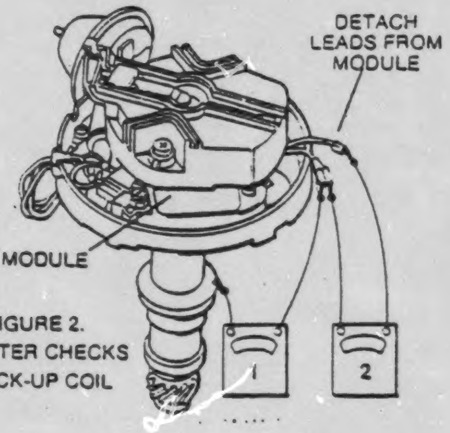


FIGURE 2.
OHMMETER CHECKS
OF PICK-UP COIL

1. You are reading the ohmmeter set up (1). Throughout the vacuum range, the ohmmeter reads infinity at all times:

____ a. you have the meter leads shorted
b. the meter leads are open somewhere
c. the resistance is incorrect, replace pick-up coil
d. resistance is correct, proceed with next step in check

2. You now are observing the ohmmeter reading in set up (2). Throughout the vacuum range, the ohmmeter reads +/- 1000 ohms at all times. Assume all preparations are correct for the test:

____ a. a reading of 500-1500 ohms is typical
b. replace the pick-up coil, the resistance is incorrect
c. a malfunction exists, the resistance should vary with throughout the vacuum range
d. replace the module, the reading should be infinity.

Unit 7.0 - Electrical and Ignition Systems

## Answer Sheet

Matching

1. b
2. d
3. c
4. f
5. h
6. i
7. a
8. j
9. l
10. g
11. m
12. e
13. n
14. o
15. k

Tasks 7.01 - 7.03

a. spark plugs
b. coil
c. vacuum advance
d. distributor (points, condenser, rotor)
e. spark plug leads

Task 7.01 - 7.02

1.
2.
3.
4.

## Unit 7.0 - Electrical and Ignition Systems

### Answer Sheet Con't.)

**Task 7.05**

1. f
2. d
3. c
4. a

**Task 7.18**

1. c
2. d

**Task 7.26**

1. c
2. b
3. a

**Task 7.23**

1. c
2. c

**Task 7.27**

1. a
2. 
   1. g
   2. c
   3. a
   4. h
   5. b
   6. f
   7. d
   8. e

3. c

**Task 7.29-a**

1. b
2. b
3. true

**Task 7.29-b**

1. d
2. a

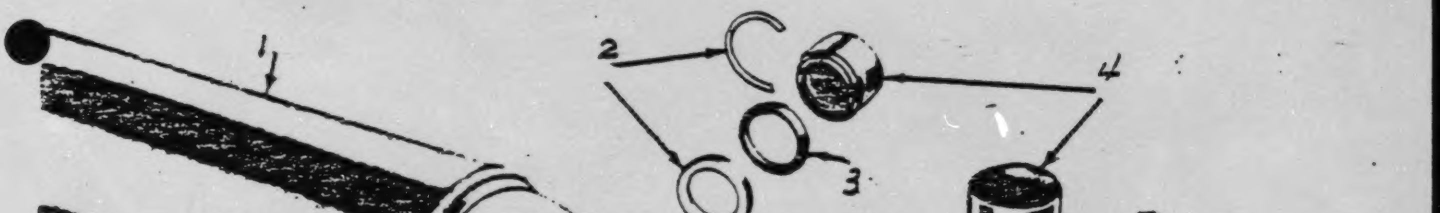
## UNIT 8.0 B - DRIVE TRAIN WITH MANUAL TRANSMISSION MAINTENANCE AND REPAIR

## OUTCOME-REFERENCED TESTS

TASK 8.02

Identify the parts of the UNIVERSAL JOINT in the space provided.

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________
11. ____________________
12. ____________________
13. ____________________
14. ____________________
15. ____________________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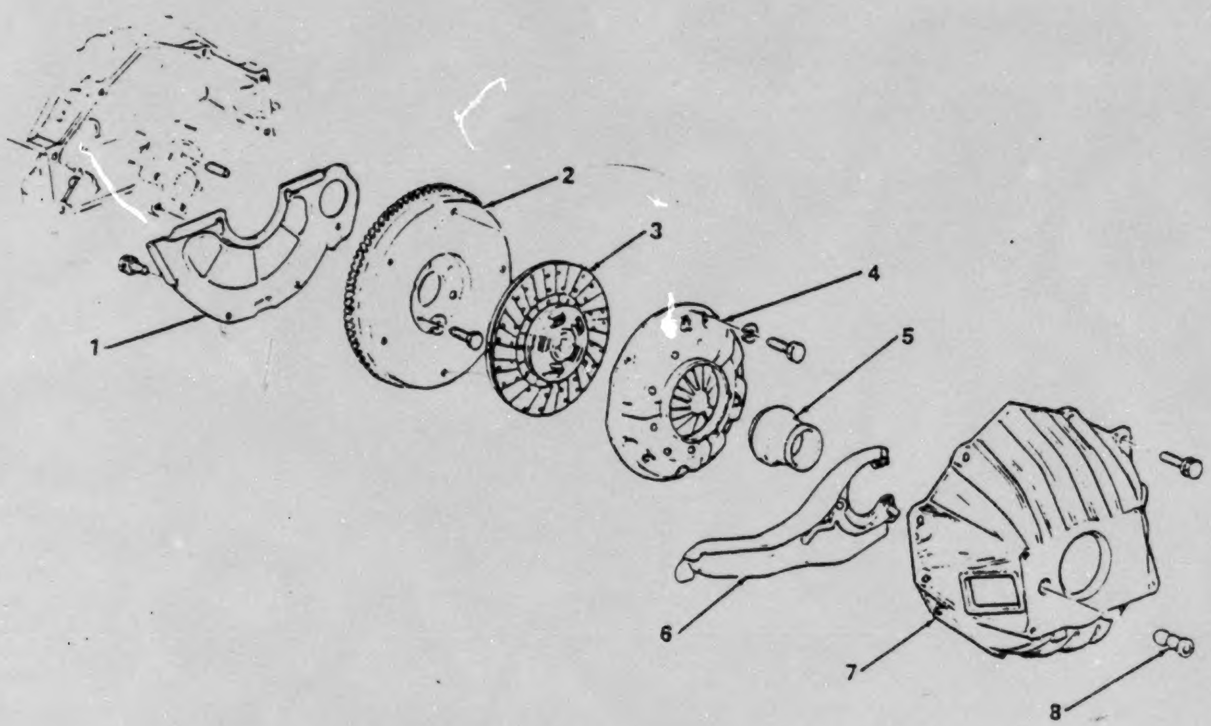
## UNIT 8.0 B - DRIVE TRAIN WITH MANUAL TRANSMISSION MAINTENANCE AND REPAIR

### OUTCOME-REFERENCED TESTS

TASKS 8.01 and 8.05

Identify the parts of the CLUTCH in the spaces provided below.

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________



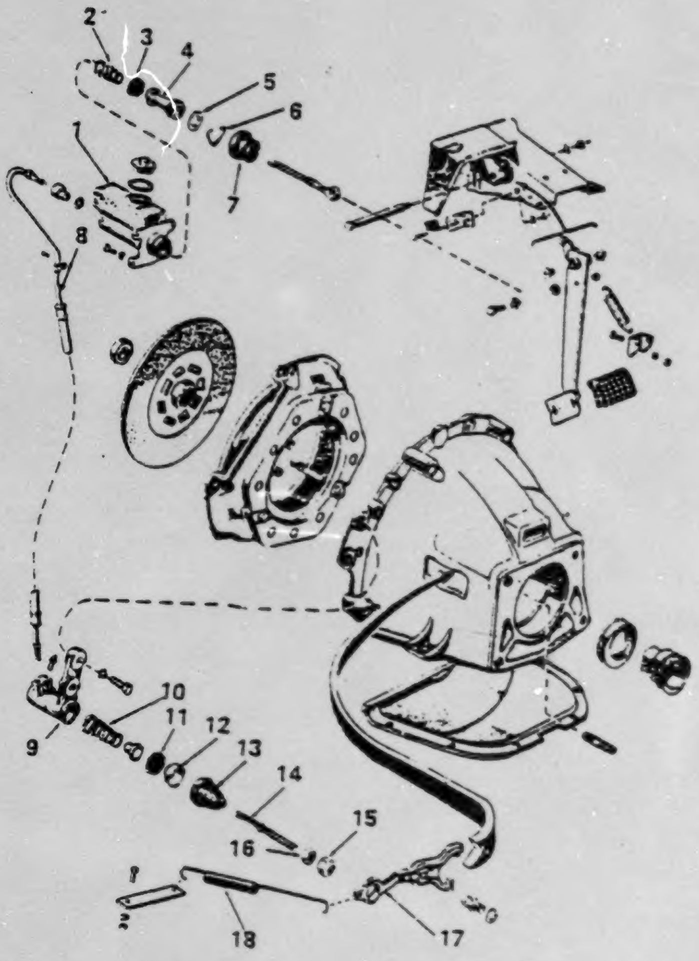
## UNIT 8.0 B - DRIVE TRAIN WITH MANUAL TRANSMISSION MAINTENANCE AND REPAIR

## OUTCOME-REFERENCED TESTS

### TASK 8.05

Identify the parts of the HYDRAULIC CLUTCH LINKAGE in the spaces provided below.

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________
11. ____________________
12. ____________________
13. ____________________
14. ____________________
15. ____________________
16. ____________________
17. ____________________
18. ____________________


2
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15
16
18
17

## UNIT 8.0 B - DRIVE TRAIN WITH MANUAL TRANSMISSION MAINTENANCE AND REPAIR

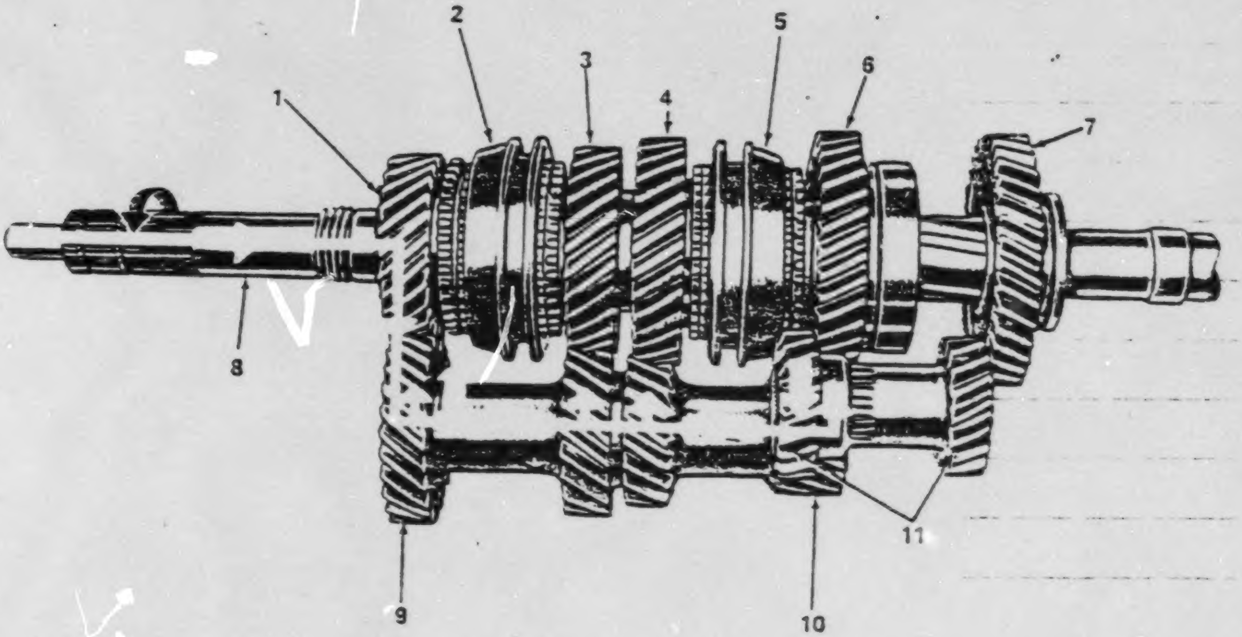
## OUTCOME-REFERENCED TESTS

TASKS 8.07, 8.08, and 8.09

Performance Job Sheet - Four-Speed Transmission Parts Identification

Identify the parts of a four-speed transmission in the spaces provided.

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________
11. ____________________



## UNIT 8.0 B - DRIVE TRAIN WITH MANUAL TRANSMISSION MAINTENANCE AND REPAIR

## OUTCOME-REFERENCED TESTS

TASKS 8.10, 8.11, 8.12, and 8.13

On the pictoral of a Ford DRIVE AXLE ASSEMBLY using an integral differential carrier, identify the parts labeled a-g.

a. ____________

b. ____________

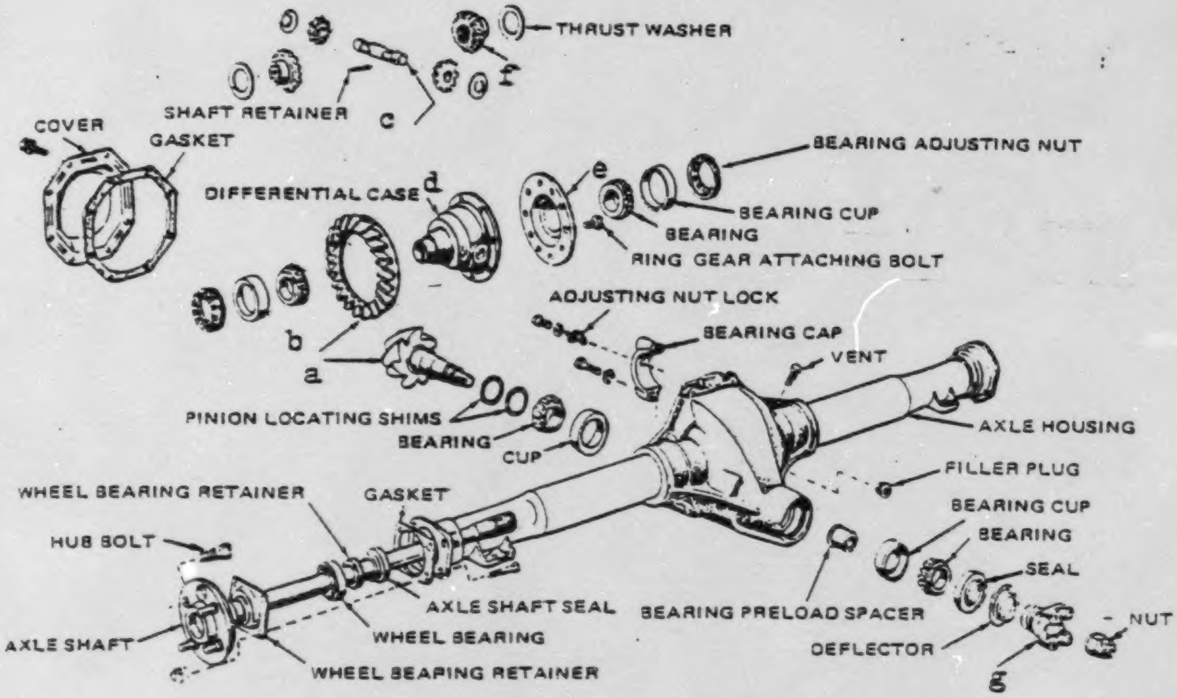
c. ____________

d. ____________

e. ____________

f. ____________

g. ____________


THRUST WASHER
f
SHAFT RETAINER
c
COVER
GASKET
BEARING ADJUSTING NUT
e
DIFFERENTIAL CASE
d
BEARING CUP
BEARING
RING GEAR ATTACHING BOLT
ADJUSTING NUT LOCK
BEARING CAP
b
a
VENT
PINION LOCATING SHIMS
BEARING
CUP
AXLE HOUSING
FILLER PLUG
WHEEL BEARING RETAINER
GASKET
BEARING CUP
BEARING
HUB BOLT
SEAL
AXLE SHAFT SEAL
BEARING PRELOAD SPACER
NUT
AXLE SHAFT
WHEEL BEARING
DEFLECTOR
WHEEL BEARING RETAINER
g

# UNIT 8.0 B - DRIVE TRAIN WITH MANUAL TRANSMISSION MAINTENANCE AND REPAIR

## OUTCOME-REFERENCED TESTS

### MULTIPLE CHOICE

1. As the clutch pedal is pressed down, the release levers will move the pressure plate away from the:

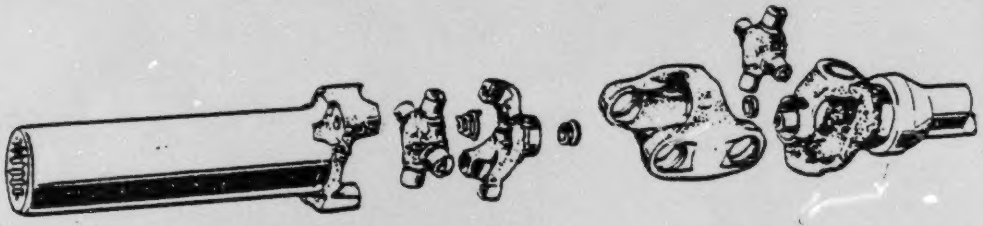
____ a. throwout bearing
b. clutch disc
c. clutch cover
d. apply springs

2. Semi-centrifugal clutch weights are generally located on the:

____ a. flywheel
b. pressure plate springs
c. clutch shaft
d. release levers

3. The universal joint pictured below:

____ a. is a constant velocity u-joint
b. does not transfer motion at uniform speed
c. is a double Cardan u-joint
d. both a and c



4. A manual transmission slips out of high gear. This can be caused by:

____ a. the transmission loose on the bell-housing
b. a worn countershaft
c. both a and b
d. neither a nor b

## PERFORMANCE JOB SHEET - DRIVE LINE INSPECTION

Before you begin:

Make of Car ______________ Model ______________ Year ___________

Time Started ________ Time Finished ________ Total Time __________

Flat Rate Time ______________________________________________

Special Tools, Equipment, Parts, and Materials

Dial Indicator

______________________________ ______________________________

______________________________ ______________________________

References

Manufacturer's Shop Manual ______________________________

Repair Manual ______________________________

Service Bulletin ______________________________

Specifications

Look up the following specification and record it in the space provided below.

Drive Shaft Runout ______________________________

PROCEDURE

1. Undercoating, mud, or any foreign material on one side of the drive shaft can throw it out of balance. A dent in the steel wall of the drive shaft can also cause it to vibrate. The drive shaft should be inspected visually for these problems.

2. Inspect universal joint flange bolts and components in the universal joints and replace as necessary.

## UNIT 8.0 C - AUTOMATIC TRANSMISSION MAINTENANCE AND REPAIR

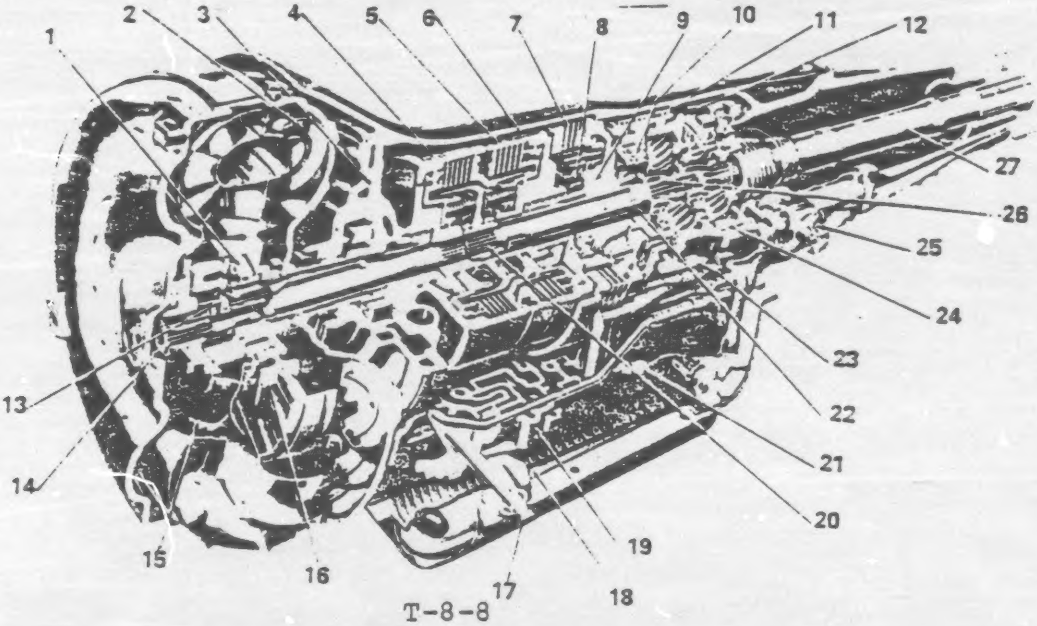
## OUTCOME-REFERENCED TESTS

TASK 8.13

### Performance Job Sheet
### Automatic Transmission Parts Identification

Identify the parts of an automatic transmission by writing the names in the spaces provided.

1. ____________________
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________
11. ____________________
12. ____________________
13. ____________________
14. ____________________
15. ____________________
16. ____________________
17. ____________________
18. ____________________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13

T-8-8

Student ______________________________ Date ____________

Section ________________ Instructor's Check ____________

## PERFORMANCE JOB SHEET
## OVERHAUL AN AUTOMATIC TRANSMISSION

Make of Car ___________ Model ___________ Year _________

Time Started ______ Time Finished ______ Total Time _______

Flat Rate Time ____________________________________

**Special Tools, Equipment, Parts, and Materials**

Transmission fluid
Clutch compressing tool
Dial indicator
____________________
____________________
____________________

Overhaul set for transmission involved
Slide hammer
Lock-ring pliers
Inch/pound torque wrench
____________________
____________________

**References**

Manufacturer's Shop Manual ____________________________

Repair Manual ____________________________________

Service Bulletin __________________________________

**Specifications**

Look up the following specification and record it in the space provided below.

Input shaft end-play ______________________________

Front pump bolt torque ____________________________

Valve body to case bolt torque _____________________

Band adjustment specifications _____________________

NOTE: Checklist for overhauling automatic transmission should be used to rate performance.

# UNIT 8.0 C - AUTOMATIC TRANSMISSION MAINTENANCE AND REPAIR

## PERFORMANCE

Road test a given vehicle with a possible transmission problem and diagnosis the problem with 100% agreement with the diagnosis of the instructor or textbook, based on available or provided data.

(Use a "Transmission Road Test Chart" and a "Diagnosis Check List" similar to the samples attached.)

# TRANSMISSION ROAD TEST CHART

Test Engagement All Ranges

| | – Engages | | Quality | | |
|---|---|---|---|---|---|
| | Yes | No | Harsh | Delayed | Normal |
| N | | | | | |
| R | | | | | |
| D-1 | | | | | |
| D-2 | | | | | |
| L | | | | | |

PRIOR TO ROAD TEST —
CHECK CORRECT FLUID LEVEL

AFTER THE ROAD TEST —
REFER TO THE DIAGNOSIS GUIDE FOR
CORRECTIONS FOR TROUBLE INDICATED
BY THE ROAD TEST.

The corrections are listed by code in the order to be inspected for corrective action to be taken.

| D-1 Range | | | O.K. | High | Low | None | Shift Quality | | |
|---|---|---|---|---|---|---|---|---|---|
| Lt. Throttle Upshifts | Shift Points in MPH | | | | | | Harsh | Slip | Normal |
| 1-2 | 6 Cyl.<br>V-8 | 5-15<br>10-15 | | | | | | | |
| 2-3 | 6 Cyl.<br>V-8 | 10-20<br>20-30 | | | | | | | |
| Closed Throttle Downshifts | | | | | | | | | |
| 3-1 | 6 Cyl. | 5-10 | | | | | | | |
| 3-2 | V-8 | 15-20 | | | | | | | |
| 2-1 | V-8 | 5-10 | | | | | | | |
| Full Throttle Through Detent Upshifts | | | | | | | | | |
| 1-2 | 6 Cyl.<br>V-8 | 35-45<br>35-45 | | | | | | | |
| 2-3 | 6 Cyl.<br>V-8 | 55-70<br>60-75 | | | | | | | |
| Full Throttle Kickdown Downshifts | | | | | | | | | |
| 3-2 | 6 Cyl.<br>V-8 | 50-65<br>55-65 | | | | | | | |
| 2-1 | 6 Cyl.<br>V-8 | 20-30<br>25-35 | | | | | | | |
| Traffic Throttle Upshifts (Moderate throttle to obtain 2-3 upshift at 30-35) | | | | | | | | | |
| D-2 Range | | | | | | | | | |
| Lt. Throttle Upshifts | Shift Points in MPH | | | | | | | | |
| 2-3 | 6 Cyl.<br>V-8 | 10-20<br>20-30 | | | | | | | |
| Closed Throttle Downshifts | | | | | | | | | |
| 3-2 | 6 Cyl.<br>V-8 | 5-15<br>10-15 | | | | | | | |
| Full Throttle Through Detent Upshifts | | | | | | | | | |
| 2-3 | 6 Cyl.<br>V-8 | 55-70<br>60-75 | | | | | | | |
| Full Throttle Kickdown Downshifts | | | | | | | | | |
| 3-2 | 6 Cyl.<br>V-8 | 50-65<br>55-65 | | | | | | | |
| Traffic Throttle Upshifts (Moderate throttle to obtain 2-3 upshift at 30-35) | | | | | | | | | |
| L-Range | | | | | | | | | |
| Upshifts | None | | | | | | | | |
| Manual Downshifts From 3rd Gear<br>D-1 D-2 Range (Do Not Make Shift Above 70 MPH) | | | | | | | | | |
| 3-2 | No Upshifts | | | | | | | | |
| Closed Throttle | | | | | | | | | |
| 2-1 | 6 Cyl.<br>V-8 | 10-20<br>10-20 | | | | | | | |

# AUTOMATIC TRANSMISSIONS DIAGNOSIS CHECK SHEET

R.O. ____________ Trans. ____________

Engine ________________________

| Code on Diagnosis Wheel | Check Test | Remarks |
|---|---|---|

☐ B — TRANSMISSION FLUID
1. Level ________ ________
2. Condition ________ ________

☐ C — ENGINE
Idle ________ ________
Power ________ ________

☐ D — EGR SYSTEM

☐ E — LINKAGE
Downshift ________ ________
Manual ________ ________

☐ F — SHIFT TESTS

| Throttle Opening | Range. | Shift | Shift Points (MPH) | |
|---|---|---|---|---|
| | | | Record Actual | Record Spec. |
| Minimum (Above 12" Vacuum) | D | 1-2 | | |
| | D | 2-3 | | |
| | D | 3-1 | | |
| | 1 | 2-1 | | |
| To Detent (Torque Demand) | D | 1-2 | | |
| | D | 2-3 | | |
| | | 3-2 | | |
| Thru Detent (wide open Throttle) | D | 1-2 | | |
| | D | 2-3 | | |
| | D | 3-2 | | |
| | D | 2-1 or 3-1 | | |

☐ G — PRESSURE TEST

| Engine RPM | Manifold Vacuum In-Hg | Throttle | Range | PSI | |
|---|---|---|---|---|---|
| | | | | Record Actual | Record Spec. |
| Idle | Above 12 | Closed | P | | |
| | | | N | | |
| | | | D | | |
| | | | 2 | | |
| | | | 1 | | |
| | | | R | | |
| As Required | 10 | As Required | D, 2, 1 | | |
| As Required | Below 3 | Wide Open | D | | |
| | | | 2 | | |
| | | | 1 | | |
| | | | R | | |

Results ________________________

________________________

________________________

☐ H — STALL TEST

| Range | Specified Engine RPM | Record Actual Engine RPM |
|---|---|---|
| D | | |
| 2 | | |
| 1 | | |
| R | | |

Results ________________________

________________________

☐ I — GOVERNOR TEST
Cutback Speed (C3, C4, C6)
10" Vacuum ______ MPH ________
0-2" Vacuum ______ MPH ________
Pressure at MPH (FMX)
10 ______ PSI ________
20 ______ PSI ________
30 ______ PSI ________

☐ J — LEAK TEST

| CHECK THESE | OK | OIL/FLUID *(COLOR) |
|---|---|---|
| CONVERTER AREA | | |
| OIL PAN GASKET | | |
| FILLER TUBE SEAL | | |
| COOLER/CONNECTIONS | | |
| LEVER SHAFT SEALS | | |
| PRESSURE PORT PLUGS | | |
| EXTENSION/CASE GASKET | | |
| EXTENSION SEAL/BUSHING | | |
| SPEEDOMETER ADAPTER | | |
| SERVO COVERS | | |
| AIR VENT | | |

| | | |
|---|---|---|
| *Color Codes | Auto. Trans. | Red |
| | Power Steering | Yellow-Green |
| | Engine Oil | Golden Brown |

☐ K — VACUUM HOSE ROUTING

☐ L — BAND AND SERVO
1. Intermediate Band Adj.
2. Reverse Band Adj.
3. Polished, Glazed Band, Drum

☐ M — DRIVESHAFT, U-JOINTS, ENGINE MOUNTS

☐ P — VALVE BODY DIRTY, STICKING

☐ Q — INTERNAL LINKAGE

☐ R — VALVE BODY BOLT TORQUE

☐ S — AIR PRESSURE TEST

☐ T — MECHANICAL PARTS

☐ U — VERIFY PROBLEM

☐ V — VALVE BODY MOUNTING FACES

☐ W — SPEEDO DRIVEN GEAR

☐ X — VACUUM TO DIAPHRAGM

☐ Y — CHECK DIAPHRAGM FOR LEAKAGE

REFER TO DIAGNOSIS WHEEL OR TO CAR DIAGNOSIS MANUAL FOR ACTION TO TAKE ON ANY "NOT OK" CONDITION.

## SAMPLE
## INSTRUCTOR'S CHECKLIST
## OVERHAUL AUTOMATIC TRANSMISSION

Procedures

U S

( ) ( ) 1. Cleaned entire outside of the transmission prior to disassembly with a steam cleaner.

( ) All openings plugged to prevent the entrance of water into the transmission.

( ) ( ) 2. Removed torque converter by simply pulling it off the stator reaction shaft.

( ) Converter placed in a pan upside down to drain. The fluid that circulates through the transmission also circulates through the torque converter.
( ) If there is any evidence of contaminated fluid either in the transmission or in the drained fluid from the converter, the converter flushed.

( ) ( ) 3. Prior to disassembly, checked transmission for gear train end-play.

( ) End-play is measured with a dial indicator. Checked planet gears for too much play. ( ) Play is corrected by one or more selective thrust washers inside the transmission.

( ) ( ) 4. Turned transmission upside down and removed the pan. Screen and valve body detached by removing their hold down bolts.

( ) Observed and noted check balls under the valve body if transmission equipped. Saved any gaskets found between the valve body halves or case to matched up with the new gaskets.

( ) ( ) 5. Removed the front pump housing.

( ) Identified if front pumps must be removed with a slide hammer or hammers by locating two threaded holes in the pump housing to connect the slide hammers.

( ) ( ) 6. With the front pump housing removed, the front clutches and planetary components removed by pulling them through the front opening in the case. ( ) The rear planetary units are taken out from the front, after the removal of snap rings on the output shaft. ( ) Extension housing removed to allow access to the governor distributor sleeve and output shaft.

( ) ( ) 7. The clutch pack assemblies disassembled, using a clutch compressing tool. First, the outside snap ring removed. The clutch piston retained by a second snap ring.

SAFETY CAUTION: This map ring is under spring pressure and should be removed only with a compressing tool.

( ) As tool removes the spring pressure by pressing on the piston, snap ring is removed. ( ) As tool is released, retainer and springs may be removed. ( ) Piston may be removed by taping the unit on a piece of wood or by applying compressed air behind the piston.

SAFETY CAUTION: ( ) Safety glasses must be worn when using an air hose.

( ) ( ) 8. All the metallic components of the transmission cleaned in a solvent tank (as necessary). The valve in the valve body may or may not be removed for cleaning, depending upon how much contamination is evident in the transmission. ( ) If the valve body disassembled, it is handled carefully so that springs and valves are not mixed up.

( ) ( ) 9. After cleaning the transmission, parts inspected carefully for abnormal wear. Replacement parts normally will be provided in an overhaul set, including all servo and clutch seals, as well as all necessary gaskets. If the transmission has very high mileage or extensive wear, the clutch discs or shaft bushings may need replacement.

U S

( ) ( ) 10. ( ) A new seal is installed on each of the clutch pistons. ( ) The new seal stretched around the piston. ( ) Seal installed in the correct direction. Piston and seal lubricated with transmission fluid and pushed into the clutch cylinder. ( ) Return spring(s) and retainer placed into position. ( ) Assembly must compressed with the clutch tool and the snap ring installed. ( ) Steel and friction discs may then be installed in the cylinder. (Steel discs installed at either end of the clutch pack may be thicker than those in the middle.)

( ) Tied the parts together on disassembly to aid in reassembly.

( ) ( ) 11. New seal is installed on each of the servo pistons.

If servo use a bonded seal requiring a new piston and seal to be replaced as a unit, piston and seal are lubricated with transmission fluid and installed in the piston bore.

( ) ( ) 12. Output shaft, governor assembly, and extension housing are replaced on the rear of the case. ( ) Planetary components may then be installed through the front case opening. ( ) Clutch packs are installed and the front pump bolted in place.

( ) Front pump bolts torques. ( ) After reassembly, rechecked the end-play with a dial indicator.

( ) ( ) 13. ( ) Replaced all the check balls in the case passages. ( ) Used the correct gaskets to mount the valve body in place on the case. ( ) Installed filter screen. ( ) Adjust the band or bands to the proper specifications. ( ) Checked that all the linkage inside the transmission properly connected.

( ) ( ) 14. Replaced the pan and pan gasket.

( ) ( ) 15. ( ) Following the overhaul instructions, assembled the transmission. ( ) Adjusted and checked tolerances ad directed. ( ) Checked to be sure that binding does not exist in the power train or torque converter. ( ) Installed new gaskets and seals.

( ) ( ) 16. If applicable, bench-checked oil pressures according to the manufacturer's specifications.

( ) ( ) 17. Installed transmission assembly in the car and attach the shifting controls.

( ) ( ) 18. Adjusted the shifting controls.

Payed specific attention linkage connected to the carburetor, if equipped.

( ) ( ) 19. Filled the transmission according to the manufacturer's instructions.

( ) ( ) 20. Tested oil pressures and band adjustments according to the manufacturer's instructions.

(All items applicable must be checked satisfactory.)

U = Unsatisfactory

S = Satisfactory

Unit 8.0 B - Drive Train With Manual Transmission Maintenance and Repair

Answer Sheet

Task 8.02

1. shaft
2. retainer
3. seal
4. bushing and rollers
5. seal
6. retainer
7. sliding yoke
8. retainer
9. seal
10. bushing and rollers
11. bushing and rollers
12. seal
13. retainer
14. cross
15. retainer

Task 8.01 and 8.05

1. clutch housing cover
2. flywheel
3. driven plate assembly
4. pressure plate and cover assembly
5. throwout bearing
6. clutch fork
7. clutch housing
8. clutch fork ball stud

Unit 8.0 B - Drive Train With Manual Transmission Maintenance and Repair

Answer Sheet (Con't.)

Task 8.05

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

12.

13.

14.

15.

16.

17.

18.

Task 8.07, 8.08, and 8.09

1.

2.

3.

4.

5.

6.

7.

8.

9.

10.

11.

Tasks 8.10, 8.11, 8.12 and 8.13

a. pinion

b. ring gear

c. differential pinion shaft

d. differential case

e. differential case cover

f. differential side gear

g. flange

Multiple Choice

1.

2.

3.

4.

## UNIT 9.0 - WHEELS AND TIRES

## OUTCOME-REFERENCED TESTS

### TRUE-FALSE

1. ____ To remove a wheel from a car, you first set the parking brakes.

2. ____ When inspecting a tire, you notice that the treadwear indicator is showing, and the tread depth is 1/16 inch or less. The tire is safe for the driver to make a 500 mile trip.

3. ____ After raising a car so the tires are about 2 inches off the floor, you would proceed to remove the wheels by removing the loosened nuts holding the wheel to the hub. Then, remove the wheel.

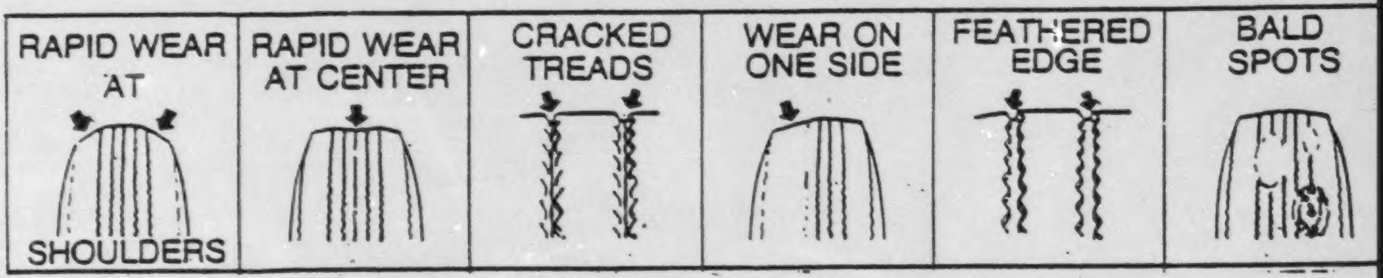
4. ____ When dismounting a front tire, mark a line across the tire and rim so that the tire can be put back onto the rim in the same position. This will preserve the alignment of the front end.

5. ____ When mounting a tubeless tire, first inflate the tire to fill out the sidewall.

# UNIT 9.0 - WHEELS AND TIRES

## OUTCOME-REFERENCED TESTS

Based on the following illustrations of six different tire wear patterns, identify the most probable cause and the typical correction actions that would be recommended.


RAPID WEAR AT SHOULDERS
RAPID WEAR AT CENTER
CRACKED TREADS
WEAR ON ONE SIDE
FEATHERED EDGE
BALD SPOTS

1. 2. 3. 4. 5. 6.

PROBABLE CAUSE

1. ____
2. ____
3. ____
4. ____
5. ____
6. ____

a. incorrect toe
b. excessive camber
c. wheels unbalanced
d. under inflation
e. under inflation or excessive speed
f. over inflation

Describe the typical corrective action to recommend in each of the above problems (illustration 1-6). (Short answers)

1. ______________________________
2. ______________________________
3. ______________________________
4. ______________________________
5. ______________________________
6. ______________________________

Unit 9.0 - Wheels and Tires

## Answer Sheet

### True-False

1. true
2. false (tire should be replaced)
3. false (safety stands under frame, then proceed to remove wheel)
4. false (preserves balance of tire and wheel)
5. false (about 40 psi)

### Probable Cause

1. d
2. f
3. e
4. b
5. a
6. c

UNIT 10.0 - STEERING AND SUSPENSION

OUTCOME-REFERENCED TESTS

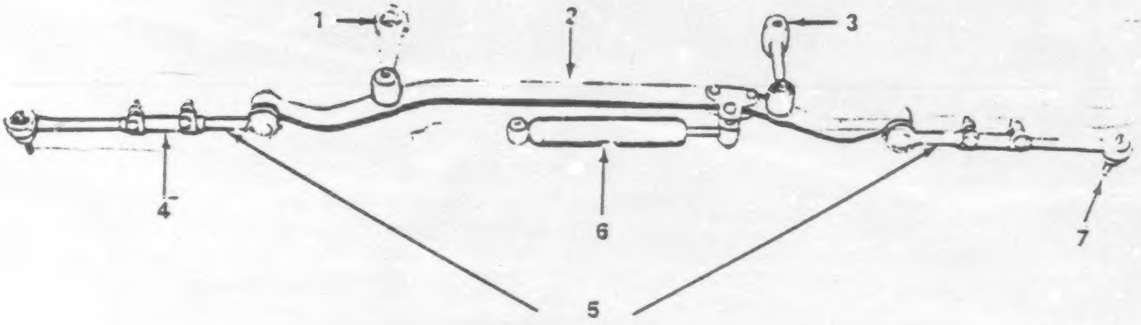
Task 10.04

Performance Job Sheet

Steering Linkage: Identification

1. Identify the parts of the STEERING LINKAGE in the spaces provided below:

    1. ______________________
    2. ______________________
    3. ______________________
    4. ______________________
    5. ______________________
    6. ______________________
    7. ______________________



Task 10.04 (Con't.)

2. Identify the parts of the exploded view of the STEERING LINKAGE in the spaces provided below.

1. ____________________

2. ____________________

3. ____________________

4. ____________________

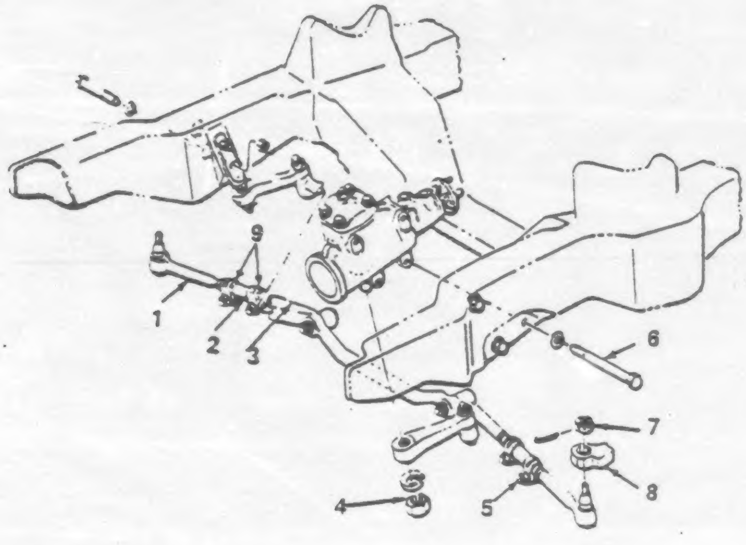
5. ____________________

6. ____________________

7. ____________________

8. ____________________

9. ____________________

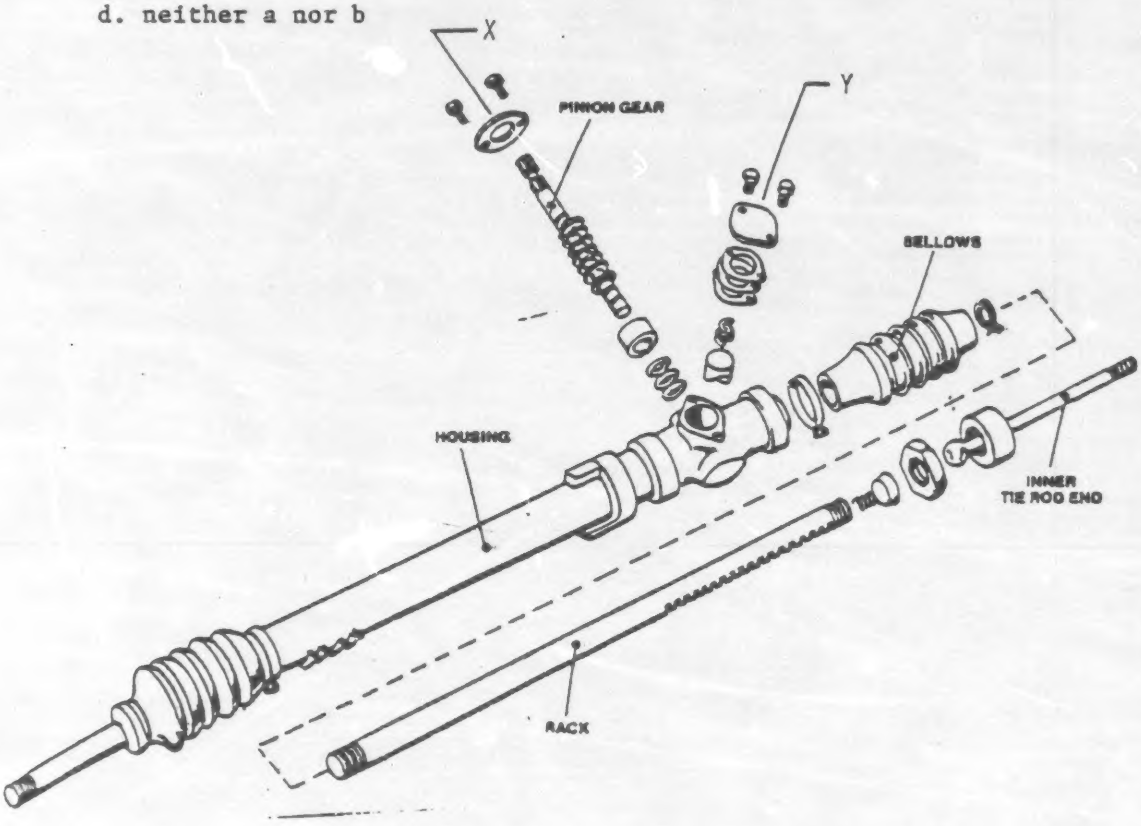


## OUTCOME-REFERENCED TESTS

TASK 10.11

A rack and pinion steering system is shown below. Student A says that rack lash is adjusted at point X. Student B says that pinion preload is adjusted at point Y. Who is right?

____ a. student A
b. student B
c. both a and b
d. neither a nor b


X
PINION GEAR
Y
BELLOWS
HOUSING
INNER
TIE ROD END
RACK

TASK 10.25

The following alignment settings would result in which of the described conditions?

____ a. left tire wear on inside, car does not pull to either side
b. right tire wear on inside, car pulls to left
c. right tire wear on outside, car pulls to left
d. right tire wear on outside, left tire wear on inside, car pulls to left

| | Readings | | Specs |
|---|---|---|---|
| | Left | Right | Left or Right |
| Camber | +3/4° or +45 min. | -1 1/2° or -1° 30 min. | 0 to +1/2° or 0 to + 30 min. |
| Caster | 0° | 0° | 0° to + 1° |
| Toe-in | 1/16" or .16mm | | 1/16" to 3/16" or .16mm to .48mm |

## UNIT 10.0 - STEERING AND SUSPENSION

## OUTCOME-REFERENCED TESTS

### TASK 10.14 - PERFORMANCE TEST

On a given vehicle, using tools, equipment, and service manual provided by the instructor; adjust worm gear end play and hi-points in accordance with manufacturer's procedures and specifications. Road test the service vehicle for proper performance. The completed job must be to the instructor's standards.

### TASK 10.18 - PERFORMANCE TEST

On a given automobile, using information, tools, and equipment furnished by the instructor; visually inspect the front suspension system for worn or damaged parts and report the findings. Findings must agree with the instructor's findings (100%).

### TASK 10.23 - PERFORMANCE TEST

On a vehicle provided by the instructor, using information, tools, and equipment to include a wheel balancer and wheel weights and a wheel assembly; balance the assembly. A static and dynamic balance is recommended. The balanced wheels and tires must not exhibit any "wheel tramp" (hopping up and down) or "wobble" (shimmy). The maximum time allowed for the adjustment is one hour per wheel. The instructor's standards must be met.

### TASK 10.25 - PERFORMANCE TEST

On a furnished vehicle with the front end out of alignment, using the special tools, equipment, and service manual provided; check the wheel alignment angles and align the front wheel following the manufacturer's specifications and procedures. The maximum time allowed is two hours, but may very depending upon the type of vehicle as decided by the instructor. Adjustment must be to recommend settings. The vehicle must meet the manufacturer's specifications and the instructor's standards.

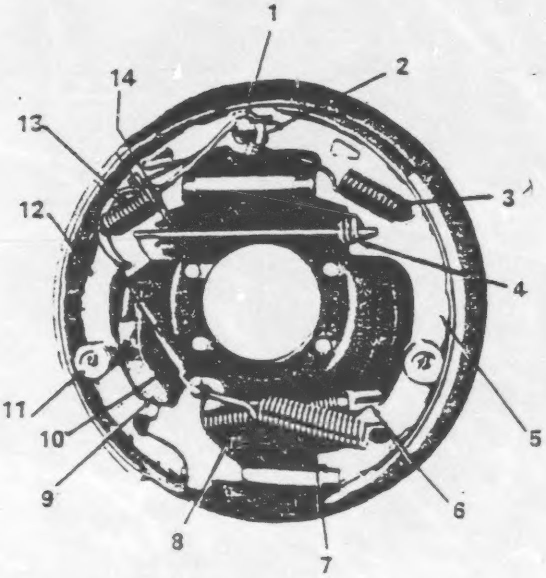
## UNIT 11.0 - BRAKING SYSTEM MAINTENANCE AND REPAIR

## OUTCOME REFERENCED TESTS

TASK 11.16

Identify the parts of the DRUM BRAKE ASSEMBLY in the spaces provided.

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________
6. ______________________
7. ______________________
8. ______________________
9. ______________________
10. ______________________
11. ______________________
12. ______________________
13. ______________________
14. ______________________


1
2
14
13
3
12
4
5
11
10
9
6
8
7

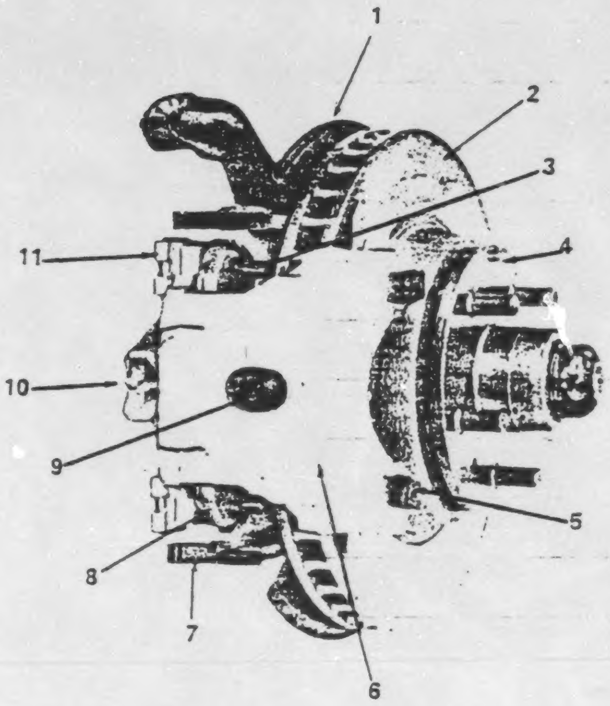
## UNIT 11.0 - BRAKING SYSTEM MAINTENANCE AND REPAIR

## OUTCOME-REFERENCED TESTS

### TASK 11.17

Identify the parts of the DISC BRAKE UNIT by writing the names in the spaces provided.

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________
6. ______________________
7. ______________________
8. ______________________
9. ______________________
10. ______________________
11. ______________________

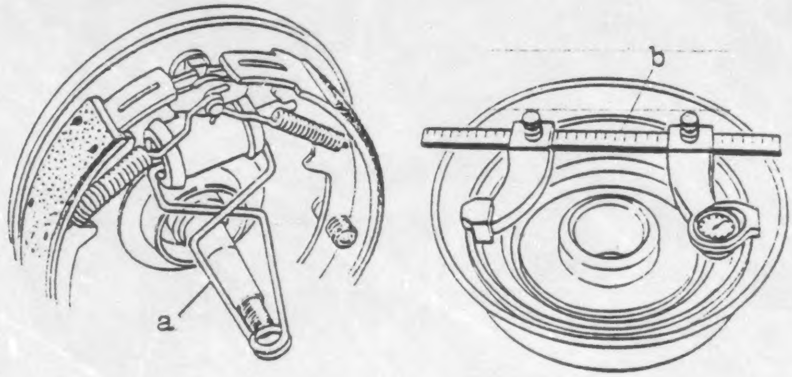


### TASKS 11.16 - 11.18

Brake overhaul work generally requires special tools such as the ones in the illustration below. Identify these tools:

a. ________________

b. ________________



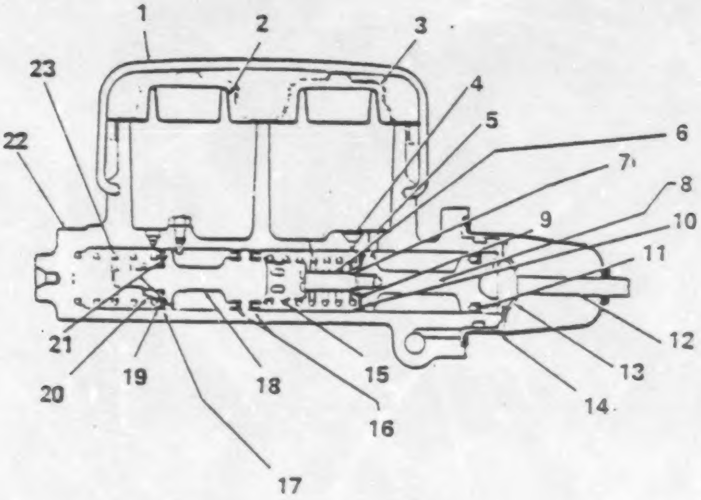
## UNIT 11.0 - BRAKING SYSTEM MAINTENANCE AND REPAIR

## OUTCOME-REFERENCED TESTS

TASK 11.21 A

Identify the parts of the MASTER CYLINDER in the spaces provided.

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________
6. ______________________
7. ______________________
8. ______________________
9. ______________________
10. ______________________
11. ______________________
12. ______________________
13. ______________________
14. ______________________
15. ______________________
16. ______________________
17. ______________________
18. ______________________
19. ______________________
20. ______________________
21. ______________________
22. ______________________
23. ______________________
24. ______________________


1
2
3
23
4
5
22
6
7
8
9
10
11
12
21
13
15
20
19
18
14
16
17

## UNIT 11.0 - BRAKING SYSTEM MAINTENANCE AND REPAIR

## OUTCOME-REFERENCED TESTS

### TASK 11.10 - CONCEPT DEMONSTRATION

On a vehicle with possible braking system malfunction or problem (or using given hypothetical symptoms) and using necessary tools, equipment, and materials as well as provided service manual; inspect the braking system of the vehicle and diagnose the probable problem(s).

(Instructor's note: Causes and corrections may be found in a number of publications such as Auto Service and Repair by Stockel.)

The recommended corrections must agree 100 percent with the instructor's recommendations or textbook/service manual recommendations.

### TASK 11.23 - PERFORMANCE

On a given vehicle, using service manual, necessary tools and equipment provided; perform an operational brake inspection (test) according to the manufacturer's procedures and tolerances. The inspection should be accomplished within twice the time allowed by the flat rate manual. Note any malfunctions in:

brake pedal and master cylinder
stoplight switch
wheel cylinders and brake shoe assemblies
brake drums
disc brakes
seals
parking brake
brake lines and hoses
chassie

Drive the vehicle to test brake action. The vehicle should stop quickly, smoothly, and with no tendency to dive or pull to the side. The inspection findings must match the findings of the instructor 100 percent.

(Note to student: Observe safety precautions during this test situation.)

Student ______________________________ Date ________________________

Section _________________ Instructor's Check ________________________

## PERFORMANCE JOB SHEET

## ADJUSTING BRAKES

Make of Car ____________________ Model __________ Year ____________

Time Started __________ Time Finished ________ Total Time ________

Flat Rate Time ______________________________________________________

### Special Tools, Equipment, Parts, and Materials

Lift jack ______________________________

Stationary jack ______________________________

Brake adjusting tool ______________________________

______________________________ ______________________________

### References

Manufacturer's Shop Manual __________________________________________

Repair Manual _______________________________________________________

Service Bulletin ____________________________________________________

## SAMPLE INSTRUCTOR'S CHECKLIST

## ADJUSTING BRAKES

A U Recommended Procedure

( ) ( ) 1. Lift the vehicle on a hoist or jack and support with jack stands.

SAFETY CAUTION: Make sure the transmission is in neutral and the emergency brake is applied.

( ) ( ) 2. Check the master cylinder fluid level.

( ) ( ) 3. Remove rubber plugs from backing plates.

SAFETY CAUTION: Brake dust contains asbestos. Do not blow the dust in the air because it is dangerous to breathe.

( ) ( ) 4. Locate the star adjusting wheel.

( ) ( ) 5. Use a screwdriver or brake adjusting tool to turn the adjuster in a direction to expand the shoes against the drum.

( ) ( ) 6. Adjust the brakes in an outward direction until the wheel is difficult to turn.

( ) ( ) 7. Back the adjuster wheel off until the wheel turns freely but with a small amount of drag.

( ) ( ) 8. Adjust each of the other assemblies in the same way.

( ) ( ) 9. Lower the vehicle.

( ) ( ) 10. Test drive the vehicle and check brake operation.

SAFETY CAUTION: Obtain permission from your instructor before test driving a vehicle.

A = Acceptable

U = Unacceptable

Student ______________________ Date ______________________

Section ____________ Instructor's Check ______________________

SPECIFICATION CARD WORKSHEET

Specification taken from publication; ______________________

1. Year ______________
2. Car Make ______________
3. Number of Cylinders ________
4. Displacement ______________
5. Carburetor ______________
6. Transmission type ________
7. w/wo Anti Pollution Equip. ____
8. w/wo Air Conditioning ______
9. Spec. Card Number ________
10. Supplementary Card Number ____

11. COMPRESSION PRESSURE
(Engine Section) Spec. _____ PSI

12. COMPRESSION VARIATION
(Engine Section) Spec. _____ PSI Max. Var.

13. DISTRIBUTOR ROTATION
(Engine Section) Spec. _____ Rotation

14. AIR GAP ADJUSTMENT
(Supplementary Information) Spec. _____ Inch

15. PICKUP COIL RESISTANCE
Troubleshooting (#3) Spec. _____ to _____ Ohms

16. CRANKING VOLTAGE
(Starting Section) Spec. _____ Volts (Min.)

17. OPERATING VOLTAGE
(Charging Section) Spec. _____ to _____ Volts @_____° F

18. COIL OUTPUT
(Ignition Section) Spec. _____ KV (Min.)

19 IGNITION TIMING
(Federal) Spec. _____° _____ TDC @_____ RPM

20. IGNITION ADVANCE ° @ 2500 RPM
(Ignition Section) Spec. _____° to _____°
Spec. _____° to _____° Cent. Only

21. IDLE SPEED
(Fuel Section) Spec. _____ RPM (Fed.)

22. EMISSION LEVELS
(Fuel Section) Spec. _____ @ _____ RPM (Fed.)

23. FUEL PUMP PRESSURE
(Fuel Section) Spec. _____ to _____ PSI @ _____ RPM

24. FUEL PUMP VOLUME
(Fuel Section Spec. _____ PT @ _____ Sec. @ _____RPM

25. COMPRESSOR DISCHARGE SIDE
(A/C Section) Spec. _____ to _____ PSI

26. REPLACE FUEL FILTER
(Fuel System) Spec. _____ Mile Intervals

27. PRIMARY RESISTANCE (PRESTOLITE)
(ignition Coil Section) Spec. _____ to _____ Ohms

28. IGNITION CURRENT
(Ignition Section) Spec. _____ Amps

29. EGR MEANS
(Emission Control Section) ________ ________ ________

30. OSAC TIME DELAY
(Supplementary Card) _____ to _____ Seconds

31. TIC ACTIVATION TEMPERATURE
(Supplementary Card) ________° F

# SUN — 2001

# COMPUTER DIAGNOSIS TEST REPORT

Customer Name ______ Phone ______ Date ______
Address ______ City/State ______ License ______
Make/Year/Model ______ Mileage ______ Mileage Since Tune-Up ______
Engine ______ Transmission — Auto ☐ Std ☐ Air Conditioning — Yes ☐ No ☐
Carburetor ______ Ignition Type ______ Air Pump — Yes ☐ No ☐ Converter — Yes ☐ No ☐
Reason For Tests ______ Tested By ______

| TEST MODE | TESTS | READ | ENTER SPECIFICATIONS | | TEST RESULT | GO | NO GO |
|---|---|---|---|---|---|---|---|
| #1 CRANKING | BATTERY | COMPUTER | VOLTS (MIN) | | | | |
| | STARTER DRAW | COMPUTER | AMPS (MAX) | | | | |
| | CRANKING SPEED | COMPUTER | RPM | | | | |
| | DYN. DIST. RES. | COMPUTER | VOLTS (MAX) | | | | |
| | DWELL | COMPUTER | DEG. | | | | |
| | REL. COMPRESSION | COMPUTER | % | | | | |
| | COIL OUTPUT | COMPUTER | KV (MIN) | | | | |
| | CRANKING VACUUM | VACUUM GAUGE | STEADY | | | | |
| #2 ALTERNATOR OUTPUT | PEAK TEST SPEED | COMPUTER | APPROX. RPM | 2500 | | | |
| | ALTERNATOR CHECK | COMPUTER | AMPS | SHOWS CHARGE | | | |
| #3 IDLE | ENGINE SPEED | COMPUTER | RPM | | | | |
| | DWELL | COMPUTER | DEG | | | | |
| | CARBON MONOXIDE | COMPUTER | % | | | | |
| | HYDROCARBONS | COMPUTER | PPM | | | | |
| | INITIAL TIMING | COMPUTER | DEG | | | | |
| | MANIFOLD VACUUM | VACUUM GAUGE | INCHES (MIN) | | | | |
| | PCV TEST | RPM & VAC GAUGE | INCHES | | | | |
| #4 LOW CRUISE | (SET ENGINE SPEED) | COMPUTER | APPROX RPM | 1500 | | | |
| | CARBON MONOXIDE | COMPUTER | % | | | | |
| | HYDROCARBONS | COMPUTER | PPM | | | | |
| | IGN. SECONDARY - REQ | COMPUTER | KV (MIN) | | | | |
| | IGN. SECONDARY - REQ | COMPUTER | KV (MAX) | | | | |
| | COIL POLARITY | SCOPE (DISPLAY) | VISUAL | | | | |
| | | SCOPE (DISPLAY) | KV (MIN) | | | | |
| | SECONDARY INSULATION | SCOPE (DISPLAY) | VISUAL | | | | |
| | SECONDARY RESISTANCE | SCOPE (RASTER SHIFT) | VISUAL | | | | |
| | COIL & COND. CONDITION | SCOPE (RASTER SHIFT) | VISUAL | | | | |
| | BREAKER POINT COND. | SCOPE (RASTER SHIFT) | VISUAL | | | | |
| | CAM LOBE ACCURACY | SCOPE (RASTER SHIFT) | VISUAL | | | | |
| | ALTERNATOR CONDITION | SCOPE (SPEC. PATTERNS) | EVEN RIPPLE | | | | |
| | MANIFOLD VACUUM | VACUUM GAUGE | INCHES (MIN) | | | | |
| #5 AUTOMATIC POWER BALANCE | CYL. RPM CHANGE | COMPUTER | BASE SPEED | | | | |
| | 1 2 3 4 | 5 6 7 8 | EVENNESS | | | | |
| #6 SNAP ACCELERATION | PEAK TEST SPEED | COMPUTER | APPROX RPM | 2500 | | | |
| | CARBON MONOXIDE | COMPUTER | % (MAX) | | | | |
| | PLUG NO. | COMPUTER | | | | | |
| | 1 2 3 4 | 5 6 7 8 | KV (MAX) | | | | |
| #7 HIGH CRUISE | (SET ENGINE SPEED) | COMPUTER | RPM | 2500 | | | |
| | DWELL | COMPUTER | DEG | | | | |
| | DWELL VARIATION | COMPUTER | DEG (MAX) | | | | |
| | TIMING ADVANCE | COMPUTER | DEG | | | | |
| | INITIAL + ADVANCE | COMPUTER | DEG | | | | |
| | CARBON MONOXIDE | COMPUTER | % | | | | |
| | HYDROCARBONS | COMPUTER | PPM | | | | |
| | CHARGING VOLTS | COMPUTER | VOLTS | | | | |
| | MANIFOLD VACUUM | VACUUM GAUGE | INCHES | | | | |

# SUN TUT—915/91[illegible]R

## ENGINE PERFORMANCE TEST REPORT

Customer Name ______________________ Phone ____________ Date ____________

Address ______________________ City/State ____________ License ____________

Make/Year/Model ______________________ Mileage ____________ Mileage Since Tune-Up ____________

Engine ____________ Transmission—Auto ☐ Std ☐ Air Conditioning—Yes ☐ No ☐

Carburetor ____________ Ignition Type ____________ Air Pump—Yes ☐ No ☐ Converter—Yes ☐ No ☐

Reason For Tests ______________________ Tested By ____________

| | TEST MODE | TESTS | READ | ENTER SPECIFICATIONS | | TEST RESULT | GO | NO GO |
|---|---|---|---|---|---|---|---|---|
| 1. | CRANKING BATTERY VOLTAGE | BATTERY, STARTING SYSTEM | VOLTMETER | VOLTS (MIN) | | | | |
| 2. | DWELL | BREAKER POINT SETTING | DWELLMETER | DEGREES | | | | |
| 3. | DWELL VARIATION | DISTRIBUTOR MECH. COND. | DWELLMETER | DEGREES | | | | |
| 4. | IDLE SPEED | IDLE SPEED ADJUSTMENT | TACHOMETER | RPM | | | | |
| 5. | INITIAL TIMING | SPARK TIMING SETTING | TIMING ADVANCE UNIT | DEGREES | | | | |
| 6. | TIMING ADVANCE | MECH. AND VAC. ADVANCE | TIMING ADVANCE UNIT | DEGREES | | | | |
| 7. | COIL POLARITY | COIL AND SYSTEM POLARITY | SCOPE (DISPLAY) | VISUAL | ▨ | | | |
| 8. | MAXIMUM COIL OUTPUT | COIL, COND. IGNITION PRIMARY | SCOPE (DISPLAY) | KV (MIN) | | | | |
| 9. | SECONDARY CIRCUIT INSUL. | HIGH TENSION WIRES, CAP, ROTOR | SCOPE (DISPLAY) | VISUAL | ▨ | | | |
| 10. | SPARK PLUG FIRING VOLTAGE | WIRES, PLUG & ROTOR GAPS | SCOPE (DISPLAY) | VISUAL | ▨ | | | |
| 11. | SPARK PLUGS UNDER LOAD | WORN OR FOULED SPARK PLUGS | SCOPE (DISPLAY) | KV (MAX) | | | | |
| 12. | SECONDARY CIRCUIT COND. | PLUGS, WIRES, CAP, ROTOR RESISTANCE | SCOPE (RASTER) | VISUAL | ▨ | | | |
| 13. | COIL AND COND. CONDITION | COIL WINDINGS, COND. LEAKAGE | SCOPE (RASTER) | VISUAL | ▨ | | | |
| 14. | BREAKER POINT CONDITION | POINT CLOSE, BOUNCE, OPEN, ARC | SCOPE (RASTER) | VISUAL | ▨ | | | |
| 15. | CAM LOBE ACCURACY | CYL. TO CYL. TIMING DIST. BREAKER CAM. | SCOPE (SUPERIMPOSE) | VISUAL | ▨ | | | |
| 16. | CYLINDER POWER BALANCE | ENGINE | TACHOMETER | BASE RPM | | | | |
| | | SHORTED RPM 1 2 3 | 4 5 | 6 7 | 8 | | | |
| 17. | CHARGING VOLTAGE | GEN. ALT. VOLT REG. | VOLTMETER | VOLTS | | | | |